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# How the Parthenon Was Planned

## Modern Theory and Ancient Practice[1]

*By William Bell Dinsmoor*

> *For some time he spent three nights a week with Dr. Bell, "working away at certain geometrical methods of getting the Greek architectural proportions": a business after Fleeming's heart, for he was never so pleased as when he could marry his two devotions, art and science. . . . Dr. Bell—the son of George Joseph, the nephew of Sir Charles, and, though he made less use of it than some, a sharer in the distinguished talents of his race—had hit upon the singular fact that certain geometrical intersections gave the proportions of the Doric order. Fleeming, under Dr. Bell's direction, applied the same method to the other orders, and again found the proportions accurately given. Numbers of diagrams were prepared; but the discovery was never given to the world, perhaps because of the dissensions that arose between the authors. For Dr. Bell believed that "these intersections were in some way connected with, or symbolical of, the antagonistic forces at work"; but his pupil and helper, with characteristic trenchancy, brushed aside this mysticism, and interpreted the discovery as "a geometrical method of dividing the spaces or (as might be said) of setting out the work, purely empirical and in no way connected with any laws of either force or beauty."*—(Robert Louis Stevenson, "Memoir of Fleeming Jenkin.")

THE reader may need no reminder that Virgil's poems, during the Middle Ages, were regarded as allegories and material for the practice of the black art. As regards the Parthenon at Athens, the method of its design and that of all the Greek architectural masterpieces of which it is the outstanding example, are we still in this mediæval frame of mind? I, for one, certainly feared that such was the case when, after returning from Greece, I found the world in a ferment over this very question, and was thereby incited to examine a very incomplete list of about 260 books and articles on the subject. However we may regret that the temerity of Fleeming Jenkin, in doubting his master's conclusions, resulted in depriving the world of Doctor Bell's unique theory of antagonistic forces, yet we cannot complain that there is any lack of analyses and theories by which the scheme of the Parthenon may be explained. Circles, triangles equilateral and Egyptian, Pythagorean and Platonic and Heronian, "magic squares," "whirling squares," "golden sections," "root-five rectangles," pentagons and pentagrams, hexagons, octagons, "conjoint tetragons," decagons, bisdecagons, snow crystals, musical scales, mystic numbers such as 7, 10, 40, or even odd numbers in general—yes, even King Solomon's seal—in short, all the apparatus of the astrologer, we see brought into play. Each investigator, finding that his own theory fits more or less exactly, is thereby assured that no other can be correct. From this mass of material I have selected a few typical examples, which I shall present in classified groups.

The latest published theory is also the simplest and most naïve, a so-called "module system," already published four times in the course of the last three years. The essence of this theory is that the sole purpose of the triglyphs in the frieze was to mark the modules, and that by drawing a gridiron through the centres of the triglyphs we have, in the case of the Parthenon, 15 longitudinal and 33 cross axes, which may or may not happen to hit anything within. The net result of this process in the case of the Parthenon is merely the fact, already obvious to most of us, that the outer faces of the flank walls align approximately with the centres of the second columns on the façades, the faces of the antæ approximately with the centres of the third columns on the flanks.[2] The same facts would have been apparent if we had drawn only 2 longitudinal and 2 cross axes. And why should the triglyph centres be selected as module lines rather than any other equally spaced features, the columns themselves, or even the mutules of the cornice? The latter would at least have given more chances.

An analogous system, being based upon a gridiron, is the earliest theory on the subject of the Parthenon's proportions, dating from 1787; but here Stuart has taken into account an additional element. For he decided that the term "Hekatompedos Neos" (really the name of the main chamber) was derived from an assumed hundred-foot frontage of the Parthenon, which he measured as 101 feet 1.7 inches on the top step, and therefrom deduced an Attic foot of about $12\frac{1}{8}$ inches. Since the length of the Parthenon, on the same top step, is about $2\frac{1}{4}$ times the width, with an error of only $1\frac{1}{4}$ inches too much, he assumed that this was intended to be 225 Attic feet, giving the proportions 4 : 9, that is, a gridiron with 36 squares of 25 feet on a side. Probably no theory has had more baneful effects on later archæologists than this. Almost unanimously, from that day to this, investigators have been obsessed by the idea that the first given proportions are to be sought in the rectangle of the plan of the platform, an artificial plane which to the Greeks was purely secondary. And almost unanimously the books on architecture accept those measurements of 100 × 225 Attic feet, a unit of $12\frac{1}{8}$ inches such as no Greek ever employed; thus it stands even in our latest books on Greek architecture, whereas we well know that the Attic foot was actually $12\frac{7}{8}$ inches. While Stuart was correct in assuming that dimension and proportion must go hand in hand, yet his theory is ruined by the fact that the top step actually measures $94\frac{5}{12} \times 212\frac{13}{24}$ Attic feet, forming neither simple primary dimensions nor a simple ratio.

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[1] While this article is intended as a general criticism of modern methods of analyzing the products of ancient art, it has seemed advantageous to confine the discussion to a single specific example, the Parthenon at Athens. For this is not only the best-known work of art surviving from antiquity, but it is also the point upon which converge most of the modern theories of proportion in art, and hence serves as the most convenient standard of comparison. But it should be understood that I employ the Parthenon merely as an instrument for the comparison of modern methods.

[2] It may be explained that in the illustration the lower step at each end of the inner building seems to coincide with a module line only because of an error of the modern draftsman.

This 4 : 9 theory was adopted, however, by Penrose (1851) and his immediate circle; but while Stuart had stopped at the top step, they attempted to go farther. Their first obstacle was their false metrology; but Lloyd disposed of this difficulty in the following statement: "At the present time the foot rule, with its established subdivisions, provides the grand standard of everything. . . . But in the Parthenon no such adherence to the fixed divisions of a measure obtains. We know the Greek foot to the utmost fraction (!), but, except in the dimension of the top step, we do not find the Greek foot anywhere, nor do you anywhere get its ordinary divisions. . . . When we find the most obvious and convenient system of regulation renounced, it follows that some other principle was adopted." So far Lloyd; and having thus passed from the hampering restrictions of practical construction to the realm of the abstract, everything became easy; geometrical ingenuity was given full play. It was observed that the column diameter was proportioned to the axial spacing as 4 : 9, like the plan of the top step, a fascinating coincidence. So Lloyd obtained the column diameter by subtracting the width of the triglyph from the width of the top step, and taking $\frac{4}{63}$ of the remainder; Penrose accomplished the same result by subtracting the width of the capital from the width of the top step, and taking $\frac{28}{423}$ of the remainder; each flattered himself that he had obtained the result in a manner quite Vitruvian. But think how Vitruvius would have shuddered had he been obliged first to estimate an unknown quantity and then to employ such clumsy fractions!

The Parthenon and the Mosque. Drawing by D. LeRoy 1754.

In a post-war book published with the support of the Auſtrian Ministry of Education, the author begins with the same fundamental proportions of 4 : 9 on the top step, but prefers to use the shorter Ionic foot of 11⅝ inches, obtaining dimensions of 104 × 234 feet. He makes the axial spacing $\frac{5}{36}$ of the width of the platform, or 14$\frac{4}{9}$ Ionic feet, and the column diameter $\frac{4}{9}$ of this. The proportions of the inner building are worked out on the same system, with errors of not more than 8 or 9 inches. Incidentally, the plan proportions are here worked into a system, whereby the containing rectangle is supposed to have been measured on the top step for a female divinity, on the ground line for a male divinity; and to the various divinities, furthermore, were assigned appropriate ratios—5 : 11 to Zeus, 3 : 8 to Hera, 2 : 5 to Apollo. If, therefore, we did not know that the Parthenon was a temple of Athena, we might ascertain this to be the case by finding that the simple ratio occurs on the top step, and that this ratio is 4 : 9, Athena's own. The only trouble with this system is that the temple of Poseidon at Sunium becomes female, and the temple of Zeus at Olympia becomes male on the ground line and female on the top step! In this example, too, we have an instance of the geometrical method; the diagonal of the top step cuts the points of intersection of the outer faces of the flank walls with the faces of the cross walls, that is, within 3¼ inches.

Among the simplest of the geometrical analyses is that found in a standard work, the great German "Handbook of Architecture." A diagonal of the top step (almost) forms the diagonal of the two inner chambers as well, and a line parallel to this nearly (but not nearly enough) forms the diagonal of the sunken floor enclosed by the interior columns.

The most interesting investigation by means of diagonals is, of course, the recent method known as "dynamic symmetry." The ratio 4 : 9 being "static" is now discarded in favor of a rectangle built up on the top foundation course, which was certainly not a dominant feature of the plan, being in part only roughly hewn; this rectangle, nevertheless, built up from a square, a "root-five rectangle" added to the square, and the reciprocal of the rectangle thus formed, comes within ¼ inch of fitting the total length of the building.[1] This coincidence emboldened the author of the system to declare that "Greek design is the most precise design ever made, and any interpretation of it must be equally precise." Let us test the precision of the suggested interpretation. The side of the square applied to the above-mentioned reciprocal misses by 1¾ inches the centre of the third column from each corner of the façade;[2] next, if to the small "root-five rectangle" left by this square we apply a rectangle similar to that of the entire plan minus the central "root-five rectangle," we come within 1½ inches of passing through the centre of the second column;[3] and, finally, the diagonal of this little rectangle, intersecting with an applied square, comes within ¼ inch of passing through the axial line of the peristyle;[4] and so on. Some of these discrepancies are rather large, falling quite outside the limits of variation in the building itself; each of the three central spacings on the façade must, by this geometry, be 1 inch greater than the twelve central spacings on the flank, rather than uniform with them as in the actual building;[1] so also the second spacing from each corner differs from the three central spacings on the façade, for instance, by 1⅝ inches, whereas in reality they are uniform;[2] these three varieties of spacing are inherent in the "dynamic" demonstration, which will not permit them to be equal, in spite of the requirements of the building. If, therefore, we assume that the architects planned the temple by means of "dynamic symmetry," we must nevertheless conclude that the present plan is the result of some subsequent readjustment, a readjustment which effectively obliterated the results obtained by the "dynamic" method. Possibly Ictinus and Callicrates regretted their struggles with geometry and transferred their attentions to algebra, obtaining uniformity of spacing by the use of the equations $2x + 5y = A$ (width), $2x + 14y = B$ (length)![3] Perhaps, however, I should no longer dwell upon the "dynamic" solution published two years ago; for more recently we are told that the preliminary containing rectangle may not have been the top foundation course at all; it may have been the top step, or the middle step, or even more probably the bottom step. Everything fits perfectly, wheresoever one starts, even though the initial ratios are quite different.[4] Truly, the Parthenon is most complaisant! And I have no doubt that the author of "dynamic symmetry" could solve the problem, not merely in four, but in forty different ways. Ictinus, however, designed it only in one way, and that method we have yet to discover.

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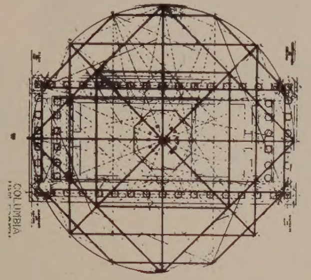
[1] The width measured on the top foundation course is 33.926 m., the length 72.546 m., giving the ratio 1 : 2.1383. If, however, we accept the width, and apply the "dynamic" ratio 1 : 2.13819, the length becomes 72.540 m., that is, only 0.006 m., or ¼ inch too short, a negligible difference.

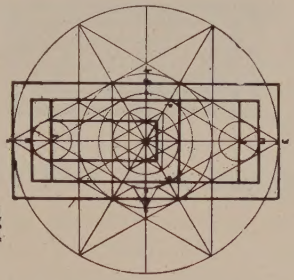
[2] The centres of the third columns actually lie 10.509 m. to 10.534 m., averaging 10.5235 m., from the edges of the outer rectangle. But the side of the above-mentioned square is to the total width as 0.69099 : 1, and so should by construction measure 23.4485 m.; the centre of the third column should therefore lie 33.926 − 23.4485 = 10.4775 m. from the edges of the rectangle. The "dynamic" distance therefore falls short by 0.0315 m. to 0.0565 m., averaging 0.046 m. (*i. e.*, 1¼ to 2¼ inches, averaging 1¾ inches).

[3] The centres of the second columns actually lie 6.2105 m. to 6.2615 m. from the edges of the outer rectangle, averaging 6.232 m. But the proportions of the little rectangle above mentioned are as 1 : 0.5913, so that by "dynamic" construction the centres of the second columns should lie 0.5913 × 10.4775 = 6.1955 m. from the edges of the outer rectangle, falling short of the truth by 0.015 m. to 0.066 m., averaging 0.0365 m. (*i. e.*, ⅝ to 2⅝ inches, averaging 1½ inches).

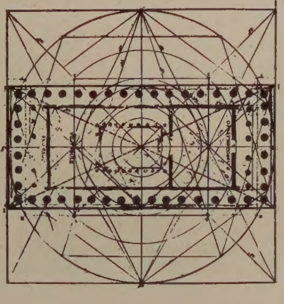
[4] The axial line of the columns actually lies 2.526 m. from the outer rectangle. By "dynamic" construction we use the same ratio 1 : 0.5913 as before, and obtain the distance as 0.5913 × 4.282 = 2.532 m., excessive by 0.006 m., or ¼ inch, a negligible quantity.



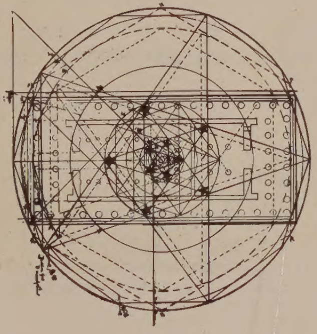
MOHAMMEDAN INFLUENCE (W. P. GRIFFITH)



JEWISH INFLUENCE (O. WOLFF)



"BINARY SYSTEM" (J. HAMBIDGE)



"AD QUADRATUM" (F. M. LUND)

POLYGONAL ANALYSES OF THE PARTHENON

One criticism made of "dynamic symmetry" is that, although it is based on nature, it is not evolution such as we find in nature, but involution; it starts not from an egg but from a containing rectangle. Therefore one investigator has adopted the opposite, and more natural, principle, starting with a small unit based on the "root-five rectangle," which grows and grows until finally the entire plan of the Parthenon has been evolved. I saw this theory demonstrated only a short time ago, and I was convinced that it fitted the Parthenon in all its parts; but since it is not yet published, I am not at liberty to describe the method.

And now let us turn to another group of investigators, those who have applied polygons of various kinds to the plan of the Parthenon.

In 1845 an architect noted that on plans of the Acropolis and of Athens, by Stuart and Revett, there was represented on the floor of the Parthenon, in dotted lines, a mysterious little octagon (or "conjoint tetragon"), of which he found no explanation in the text. He thought that it was a diagram engraved on the pavement, a key to the design considerately left there by the ancient architects. And so he proceeded to develop this octagon by evolution, in accordance with the laws of music, with the inevitable result that it perfectly fitted the Parthenon. And what was this mysterious octagon which formed the key to the ancient design? It was the outline of the little Turkish mosque, erected inside the Parthenon after the explosion of 1687, and represented by Stuart in dotted lines.

The next diagram I show only for historical reasons; it is an early effort by the author of "dynamic symmetry," probably now discarded. For this system is "static": one series of circles is arranged in a binary relation (1, 2, 4, 8), and from the triangles, squares, pentagons, and hexagons inscribed in these circles are derived the radii for another series of circles; and thus we obtain a great number of lengths, of which some inevitably fit various parts of the building.

And now let us examine the part played by Hiram, King of Tyre, in the design of the Parthenon. If I had space for the reproduction of King Hiram's design for Solomon's tem-

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[1] The actual column spacings are ⅓ (12.883) = 4.294 m. and ⅓ (12.8785) = 4.293 m. for the three central intervals on east and west respectively, and $\frac{1}{12}$ (51.504) = 4.292 m. and $\frac{1}{12}$ (51.488) = 4.291 m. for the twelve central intervals on north and south respectively. But by "dynamic" construction we have for the façades ⅓ (33.926 − 20.955) = 4.324 m., and for the flanks $\frac{1}{12}$ (72.540 − 20.955) = 4.299 m. Thus the façade spacing would exceed the flank spacing by 0.025 m., or 1 inch, the façade spacing being 0.0305 m. (1¼ inches) and the flank spacing 0.0075 m. (¼ inch) greater than the truth.

[2] The second-column spacing by this "dynamic" construction would be 10.4775 − 6.1955 = 4.282 m., as compared with 4.299 m. similarly obtained for the other flank spacings and 4.324 m. for the other façade spacings. In the latter case the discrepancy is 0.042 m. or 1⅝ inches.

[3] Being given the width, 33.926 m., and the length, 72.546 m.:

$$\begin{array}{rlrl} 2x + 14y &= 72.546 & & \\ 2x + 5y &= 33.926 & 2x &= 33.926 - 5\ (4.291) \\ \hline 9y &= 38.620 & 2x &= 12.471 \\ y &= 4.291 \text{ m.} & x &= 6.2355 \text{ m.} \end{array}$$

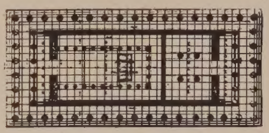
The actually measured averages are 4.292 m. and 6.232 m. respectively. Thus an algebraic solution (which I do not seriously advocate) would avoid all discrepancies.

[4] As an example of the universal applicability of "dynamic symmetry," I might note a curious instance of a clash between this and the "module system." To illustrate the latter was published a plan of the Heræum at Olympia (ARCHITECTURE, XLII, 1920, p. 209), apparently drawn by an office boy without knowledge of the fact that the flank columns are actually more closely spaced than those on the façades by 0.31 m. (more than 12 inches); for he represented them as uniformly spaced on all sides. In an attempt to controvert this system, an ardent student of "dynamic symmetry" worked over the erroneous plan and found that it perfectly fitted his own theories. But when his attention was drawn to the fact that the net result of his success was merely the proof that it was not the ancient Greek architect, but the irresponsible office boy, who had unwittingly designed the Heræum on the "dynamic" system, he refrained from publication.

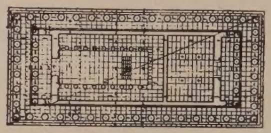
ple (as redesigned by one author on the basis of King Solomon's seal), you would be astounded to perceive that the Parthenon, as analyzed by the same author, reproduces the fundamental proportions of a Jewish prototype.

Seventy years ago a Hungarian analyzed the cathedral of his native town, Kaschau, and found that its mediæval designer had employed Plato's triangle, or the "root-three rectangle," obtaining from this by simple geometrical processes a series of radii of circles which he brought into relation with the mathematical equivalents of the musical scale. Next he found that this same system had been employed by mediæval designers all over Europe, likewise by the builders of Egyptian temples, of Solomon's temple, and of the Parthenon as well. The top step, with its 4 : 9 ratio, formed the basis of the design.

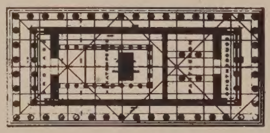
I have been unable to find that book in New York, and therefore cannot reproduce the plan; but I mention the theory because of the coincidence that now, after seventy years, a Norwegian investigator has found a very different key to the same secret in the cathedral of his native town, Throndhjem. And after perceiving that it, too, fitted all the mediæval buildings of Europe, he discovered that it was the basis of Solomon's temple as well, and, of course, of the Parthenon. So impressed were the Norwegian Parliament with this discovery of "ad quadratum," that they had it officially published in Norway, and sumptuous editions have just appeared in both London and Paris. Again we find a maze of circles, of which the radii are related to each other according to the "golden section," constructed on the basis, this time, of the lowest step; and about them are circumscribed or inscribed decagons, hexagons, pentagons, and pentagrams. Coincidences, of course, will happen; thus a decagon inscribed within a circle of which the diameter is the diagonal of the top step coincides, without a millimetre's variation, with the length of the bottom step. And I have no doubt that a little error of $41\frac{5}{8}$ inches, in the claim that the length of the top step is ten times the side of a pentagon formed within the pentagram inscribed within the circle based on the width of the top step, could be eliminated by further study.[1]



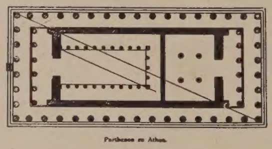
THE "MODULE SYSTEM" (AFTER E. PLAGC)



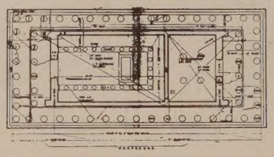
THE PERSONIFIED DIAGONAL (M THEUER)



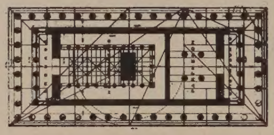
THE "HEKATOMPEDON" (AFTER J. STUART)



PARALLEL DIAGONALS (A. THIERSCH)



PROGRESSIVE RATIOS (W. W. LLOYD)



"DYNAMIC SYMMETRY" (AFTER J HAMBIDGE)

RECTANGULAR ANALYSES OF THE PARTHENON

A colleague of mine at Columbia University,[2] recently selected at random a photograph of a steam-pump from a trade catalogue, and found that it worked out perfectly, containing rectangle, location of valves, and all, according to the "golden section," 1.618. But he does not therefore claim that the engineer who designed that steam-pump consciously proportioned it according to the "golden section," or that an earnest and successful attempt to make it an object of beauty caused its parts unconsciously to follow the divine law.

What is the explanation of all these remarkable coincidences when they are coincidences? It is undoubtedly to be found in the mathematical theorem, to the effect that between any two lengths, selected at random, a great number of simple geometrical relations can always be found, merely by the use of sufficient patience and ingenuity. Hence it is that between the width and length of any temple, measured on any plane, we may expect to find, not one, but many geometrical relations which may at first sight seem convincing. Let me quote a sentence from Perrot and Chipiez: "Whatever their degree of exactness, operations of this kind, which may be executed in indefinite number, are, in fact, more specious than convincing."

We may, I think, congratulate many of these investigators because of their ingenuity and geometrical skill; but giving such modern inventions Greek paternity, in the attempt to supply an aristocratic lineage, is a tendency against which I must protest.

Can you wonder, after viewing these fairly representative analyses of the plan of the Parthenon, that there exists another school of thought, one of absolute revolt against the idea that the Greeks used formulas in design? But the supposition that the Greeks were so gifted with innate and instinctive taste that they obtained perfection without any definite method is, I think, supported only by those who despair of finding any more logical explanation of the proportions of Greek art. As Van Brunt has stated: "It is a mistake to suppose that architectural proportions are the result of instinct." And such a supposition is refuted by the titles of numerous books on the theory of proportion published by the ancient Greek architects and other artists, and by the references to proportion in the works of the philosophers such as Plato and Aristotle.

(*To be continued*)

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[1] In a recent article in *The Nineteenth Century* (XCI, 1922, pp. 521–32) Sir Theodore A. Cook unnecessarily scores the proposed rebuilding of the Parthenon on the ground that it will be made a vehicle for the application of "dynamic symmetry" or "ad quadratum." But ten years of association with the Greek architects in charge have convinced me that the temple runs no such danger, for they will be guided solely by the internal evidence of the stones themselves.

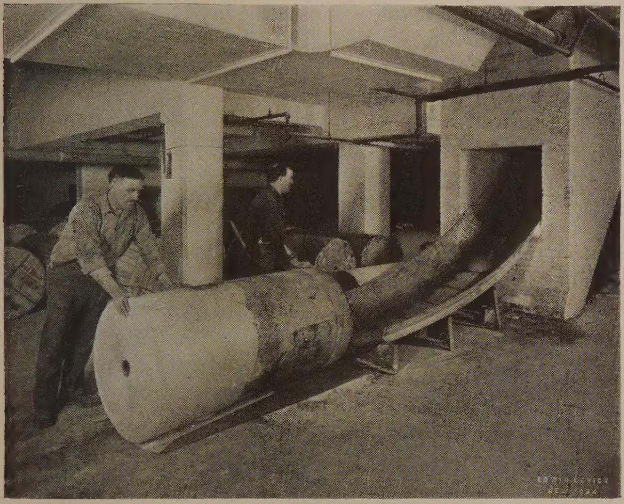
[2] Mr. H. Vandervoort Walsh.

# New Building for the New York "Tribune"

225 West 40th Street, New York City

Lockwood, Greene & Co., Engineers and Architects

THE requirements of the New York *Tribune* for their new building at 225 West 40th Street, New York City, were, first, a newspaper factory of the highest efficiency of operation; second, a building operation of the lowest practical cost; third, a structure architecturally in keeping with the business to be housed and with the dignity of the paper.



Paper storage-room. The rolls are dropped down a chute from the street and carried on the commercial railway tracks to the reel-room.

The major departments of a large daily paper—*The Tribune*, for a case in point—are news-room, composing-room, press-room, and mailing-room. Supplemental departments are the administrative offices, including circulation and advertising; department of art, comics, special features, and paper-storage section. Mat machines for making the moulds from which the printing-shells for the presses are cast are generally placed in the composing-room, and the stereotype machines for casting the shells adjoining the press-room. Stone reels, if used, necessitate considerable space allotment. Paper storage in the building sufficient to assure a certain supply of news print is desirable, to avoid outside storage charges, rehandling, and to permit favorable purchasing.

The industrial engineering work on this project involved the determination of the best departmental arrangement for efficient production.

A mailing-room on ground floor, for truck delivery, is obviously desirable, with circulation department adjoining mailing, and an advertising department for the convenience of advertisers.

To avoid the rental of outside space and rehandling costs, ample paper storage in the building was required. To permit quick disposal of news print from trucks by gravity chute, a basement storage is desirable; furthermore, any basement space, on account of restriction of light and natural ventilation, is less desirable for manufacturing departments.

The question of the possible use of stone reels with the presses was an important one, and the economics of their use was very thoroughly studied. The use of reels results in an obtainable production of ten to thirty per cent more than otherwise, and our studies proved that the floor space and equipment involved was well warranted by the higher output secured. For supervision, maintenance, and operation it is very desirable to have all presses together, as the press-room would naturally come in proximity to the mailing-room, which it feeds, and should be as close to it as possible. (Stone reels are a frame containing three rolls of news print whereby a new roll is run into press without shutting it down.) The press floor is arranged for eight double quadruple presses, four now being installed, meeting present wants.

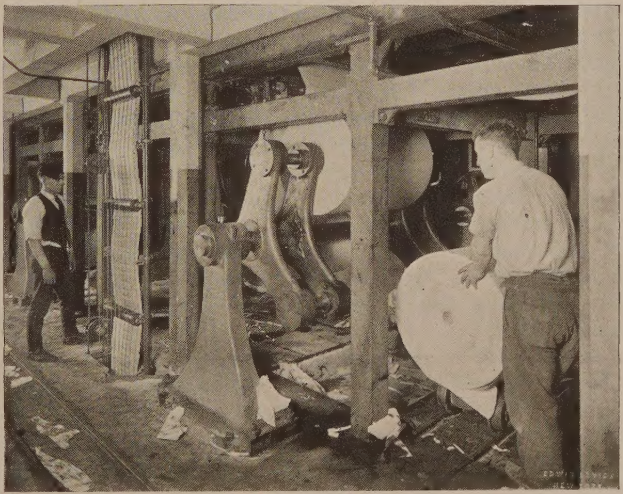
It being better to group presses together on a floor, the reels are located together on the second floor, and the presses on the third. The composing-room, including linotype machines and mat-making, comes logically on the floor above, *i. e.*, the fourth, and the news-room supplying the composing-room with copy comes on the fifth. The general offices are on the sixth, to be as close as possible to the seat of newspaper manufacture, while the art, comic, and special features which are specialties and lay in a sphere by themselves, somewhat apart from the manufacturing of the paper proper, are accommodated on the seventh floor.

It is therefore seen that the production of *The Tribune* is based on a general principle of gravity flow from the news-room on the fifth floor to the mailing-room on the first.

The news print—the material part of the product—joins in the process at the third floor and descends as a completed paper.

Having placed the departments fundamentally in the correct line for efficient production, the next step to further assist in this was the selection of conveying devices in the process.

The first such device is the gravity chute for copy from the editor's desk in the news-room to the composing-room on the floor below. This is a straight drop in a vertical sheet-iron chute, with the sure force of gravity to pull it down. No pneumatic tubes whatever are used in *The Tribune* building.



Feeding the paper to the presses from the reel-room directly below.

The next chute used is from the composing-room to the stereotype department in the press-room for delivering the mats from the mat-machines on the fourth floor to the third. This is also a gravity conveyer.

A further use of conveyers is between the press-room and mailing-room, where paper-drops, consisting of steel cables in the necessary frame, carry the finished papers to the mailing-room. These drops are driven by and geared directly to the press itself, and, running down vertically from the press delivery, are always accessible for quick repair when necessary. A frequent trouble with such conveyers by failure at this very critical point in the process has been that in many plants they have been driven by separate motors, subject to breakdown, or have been installed on ceilings or inaccessible locations where repairs are difficult and slow. With *The Tribune* layout the paper-drop runs if the press it serves is running, and it is immediately at hand for any necessary repairs.

In the mailing-room, at the delivery end of each paper-drop, the papers are bundled on a main transverse conveyer, properly located for the purpose, this conveyer delivering to a similar conveyer, which delivers the bundles onto an elevated platform at the enclosed trucking space at shipping-point. This space accommodates four trucks, and as many inclined chutes are provided from platform to load the trucks. The mailing-room conveyers are of the endless-belt type, and are motor-driven.

Incoming news print arrives on trucks in the enclosed teaming space, and is unloaded onto a gravity chute to the basement. Top of chute has rollers flush with floor and at truck-body height to give the greatest facility in handling. This chute delivers to special industrial cars operating on depressed tracks in the floor, to give flush top, and by means of switches and turntable the distribution throughout the paper-storage section is effected.

The paper going into process is also handled on the industrial track system in the basement, which serves two tracks on an elevator which lifts the news-print rolls to the second floor (reel-room), where another industrial track layout carries it to the various reels. The elevator mentioned also serves for general freight service. Two passenger-elevators are provided at the other end of the building, one of which goes to basement for handling news print to second floor in case of necessity.

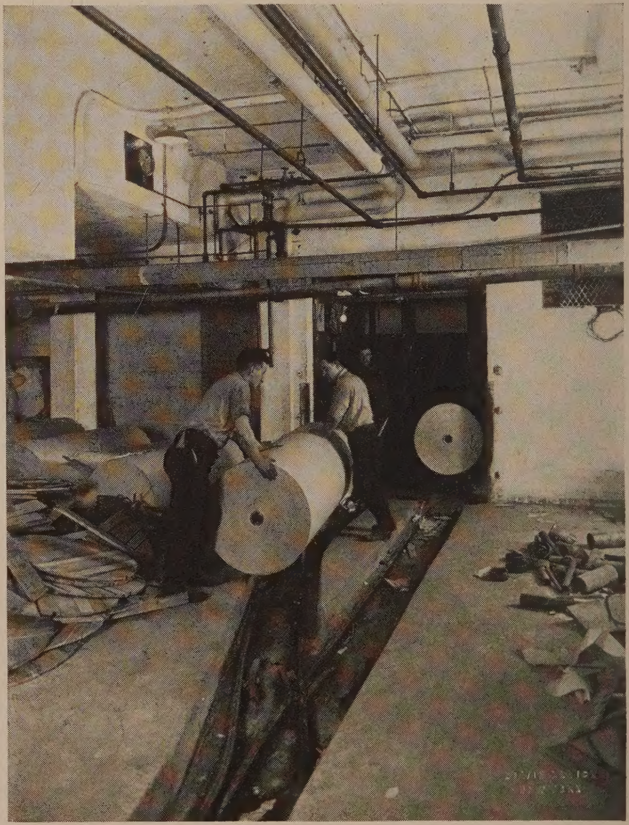
Our studies of the newspaper industry led to the solution in *The Tribune* case of a number of difficulties that have heretofore resulted in poor printing and press-room delays. It was found that the paper in other than its best condition, frequently tore, or did not take the print to the best advantage. The ink did not handle economically or work properly unless at the proper temperature. Uneven temperature or drafts on the presses tore the paper, even when the latter was in its best condition. These facts indicated the desirability of definite maintenance of uniform temperature and humidity wherever paper, ink, and presses were used; namely, the basement with its paper and ink storage, the reel-room on the second floor, and the press-room on the third floor. This has been accomplished by a central air-conditioning equipment with automatic control serving these departments.

The study of most efficient routing led to press-room location on the third floor. Such a location gave a problem of adequate support for eight 100-ton presses, and still more difficult the question of elimination from the structure the vibration of this amount of machinery. It is possible that the attempt to absorb vibration of presses so located by stiffness from foundations has been made, though unsuccessfully, before, but we know of no case in the newspaper industry where the principle of mass inertia to absorb vibration has been used. In *The Tribune* building, the presses, press foundations, reels, and the second floor of the structure are tied together integrally, and the second floor-slab is of such mass that by inertia it absorbs all the vibration of the moving machinery. Wood-block floor is used throughout the press-room as the most satisfactory material here.

A number of features of the composing-room layout are of special interest. A thorough study of electrically *vs.* gas-operated metal-pots on the linotype machines was made. With the cost of power at existing rates with either kind of energy, our studies proved that electrical operation was cheaper, largely for the reason that with electrical operation current need be turned on only one hour in advance of use, while with gas the metal-pots must be kept hot continuously. Electrical operation eliminates fumes and avoids the necessity of individual hoods and extraordinary provisions for ventilation.

Another special feature of the composing-room is the handling of service piping for the linotype machines; namely, cooling-water supply and return for metal-pots, and electric supply for linotypes in flush trenches under floor. Linotype machines are sometimes back up against a wall, with the piping racked on it, or arranged back to back in gangs along the floor, with service piping in between. Such arrangements take up space, obstruct the room, and cause interference at the aisles. In *The Tribune* composing-room, brass pipes, for durability, are used, and these with the conduits supplying electricity are carried in floor trenches, with flush covers, so that there is absolutely no interference around the machines. The composing-room throughout has a maple-top floor, which gives durability, cleanliness, and the

(*Continued on page* 196)



Tracks for handling 1200 lb. rolls of news print

# Byzantine Art

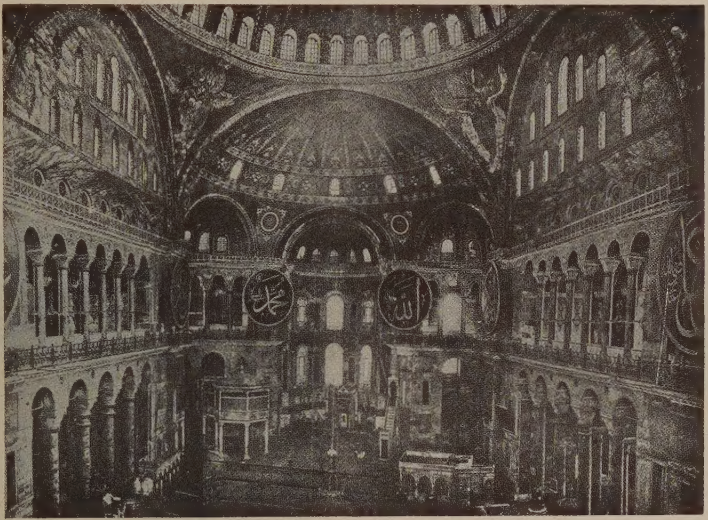
*By Professor C. R. Morey*

Princeton University

## HAGIA SOPHIA

## II

THE walls of the church from floor to the springing of the vaults are wholly veneered with marble. To this revetement the quarries of Egypt, Africa, Asia Minor, and Greece have all contributed, and Paulus Silentiarius, who wrote an ecstatic description of the church in verse soon after its completion, sings the praises of twelve varieties. The care with which the pieces are fitted, and the disregard of waste, is shown by the frequent working out of natural patterns by the veins of color in slabs adjacent to one another—the patterns of the one being continued in the other. Some of these combinations take on the shapes of human figures and faces, and have given rise to many a story. Above the marble revetement, on arch and vault, begins the wonderful mosaic decoration that covers the whole upper portion of the church. The figured mosaics are wholly or partially obscured by whitewash or overpainting at the hands of the Moslems, but this can be removed, and in view of present political conditions we may hope in time to see the great compositions again uncovered. The purely decorative parts have never been touched save for repair, and here a remarkable care is shown for the effect. The little cubes of glass that compose the mosaics have a reddish substance at their base; the gold leaf is fastened on the other end by a thin layer of glass placed over it and fused to the large cube; the red thus mingles with the translucent gold into an effect of extraordinary richness. The cubes, moreover, were not laid flat on the wall, but canted at an angle, so that the light would be reflected downward directly toward the eye of the observer. No wonder that Procopius, the historian of Justinian, and his works should declare that the place seemed to be illuminated from within rather than from without, "such is the abundance of light that is shed about this shrine." Along the spandrels of the arcades the play of light continues in the arabesques carved in marble, whose rinceaux twinkle in a rhythmic pattern of light and shade.



Interior looking East, Santa Sophia, Constantinople, Byzantine, Sixth Century.

There is no relief in this marble carving, and the surface is as flat as the mosaic itself. In fact, there is scarcely any relief in the whole decoration of the church, aside from the small cornices that mark the string-courses of the triforium and clear-story. The whole effect, whether provided by the green, white, and red columns, or by the marble revetement, or by the mosaics, or the carved marble ornament, is one of color, as if the Oriental rugs that the Turks have laid upon the floors were continued up the walls of the structure. The Greek love of form, relief, and of the third dimension, of clear ideas embodied in the human figure, is here replaced by an Eastern dissolution of thought in an infinite play of color and pattern. The mind is bewildered by unlimited repetition and variety. By the same qualities the eye is charmed. An effect wholly Oriental is thus produced on one who views the decoration alone.

Not so with the architectural design of the interior. Banish for a moment the distracting play of color, and you find a design whose sense of proportion and harmonious clearness is surely Greek. We see the same tradition in the very exactitude of the measurements, as carefully planned as in the case of the Parthenon. Thus the length of the building, including the atrium, or the colonnaded forecourt to the west of the entrance, was exactly 500 Byzantine feet; without the atrium exactly 300, and to conform to this length the apse and narthex are given an unusually small projection. The height of the dome above the pavement is just 160 feet, as against a visible length of the interior of 250, proportionate, you see, as the squares of 4 and 5. The height of the original dome was just one-fourth its breadth; another refinement of dimension can be seen in the placing of the baptistery at the southwest corner of the outside of the church exactly 100 feet from the centre of the square under the dome. Lastly, we have already noticed the care with which Anthemius concealed the disparity of the sides of the central square, and by a clever manipulation of moulding brought the apparent span of all four arches to exactly 100 feet. There are all sorts of irregularities and departures from symmetry in the details of the church—pointed arches, horseshoe arches, stilted arches, broken curves, non-alignment of the columns of the triforium with those below, etc.—but over all reigns the rigid requirement of the general proportions, which convey the ultimate effect of order to the eye.

If you will compare the broken-up and obscure interior of St. Mark's at Venice with the interior of Hagia Sophia, I think you will see better what I mean by saying that the clear disposition of Hagia Sophia is Greek. These late Byzantine churches are more Oriental in their repetition of identical units with no apparent ending, and for no apparent purpose save to charm the eye. No matter where one stands in St. Mark's, he cannot grasp the layout of the whole interior at a single glance. He can do this in Hagia Sophia, and Anthemius's great half-domes at east and west

Interior San Marca, Venice, Byzantine eleventh and twelfth century.

served not only the purpose of buttressing the main dome, but also carried the eye without interruption up to that magnificent coronation. Such simplicity, such clean-cut logic, is Greek, not oriental. Yet the almost Mohammedan vagueness of the decoration is oriental and un-Hellenic. You see now why the church gives rise to so radically differing judgments; why Diehl can call it the "type *par excellence* of Byzantine architecture," and Riegl name it the last embodiment of that intellectual beauty which is Greek.

Greek also is the treatment of space. There is an interesting contrast between the classic and the mediæval attitudes toward the use of space in architecture, which arises from the classic abhorrence of the infinite, and the courting thereof by the mediæval Christian thinker, basing as he does his whole intellectual structure upon the infinite presuppositions of Christianity. The element of the infinite enters into architecture only by the including of space as part of the effect. If you ever enter the concourse of the Pennsylvania station at New York, you can test this by the impression which that interior makes upon you. You will find that the clear *ideas* that would otherwise be given you by the forms of the columns and capitals and the contours of the vaults and stairways are blurred in the effect of the whole by the overpowering obsession of mere extent. From this last you get no idea at all, but rather a *feeling*—a welcome sensation of submergence in something vast and unlimited. This is, in fact, your reaction to the suggestion of the infinite arising from the indeterminate space of the interior.

Mediæval architecture, both of east and west—the Gothic style which finally emerged in the west, and the Byzantine which grew up in the east—both added this element of unlimited extent to the effect of their interiors. They had to, to realize in architecture the infinite concepts of Christianity. But each had its own way of doing it, owing to the differing racial elements which transformed the classic culture into the mediæval in the eastern empire and in the western. In the west it was the emotional, lyric temperament of the Teutonic tribes that changed the Roman Empire into Christian Europe; in the east it was the Oriental point of view of the half-Hellenized inhabitants of Asia and Egypt that transformed the Greek civilization into Byzantine. The conception of the infinite in the mind of the western barbarian was that of all outdoors—the everlasting variety and indeterminate reaches of a landscape, and the boundless expanse of sunlit air. The Gothic architect therefore yields more and more of his walls to windows, and develops a skeleton construction that finally permits him to abolish the walls altogether, and inclose his interiors almost entirely with glass. Thus he unites his space within with infinite space without, and to the same end tapers the forms of his exterior into spires and crockets that dissolve in air—all in a never-ending effort to relate his cathedral with the infinite space wherein he feels the embodiment of God.

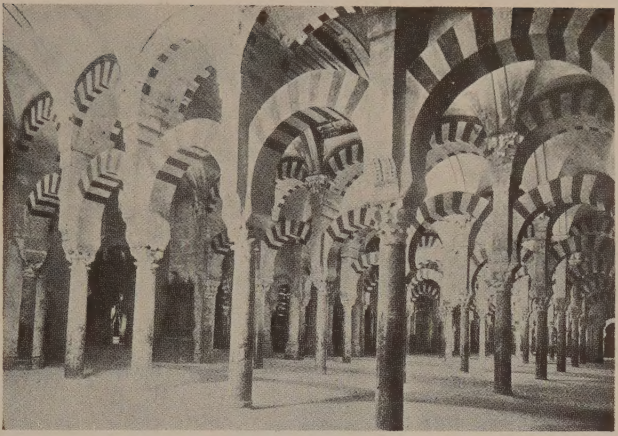
The eastern mind saw the infinite differently, less emotionally but no less mystically. To the oriental the infinite became an unlimited series, a mathematical concept of unending repetition of similar units in rhythmic recurrence. This is the æsthetic effect of such works as the flat marble carvings of Hagia Sophia, and of the bewildering expanse of flat or curved wall-space covered with mosaic design. An alternation of light and dark in color, the small motifs of ornament succeeding one another ad infinitum—all this provides more subtly but no less certainly the indefiniteness that classic art avoided, and that reaches its most striking manifestation in Moorish interiors of southern Spain.

The classic interiors use space but define it and bound it. The Pantheon, for instance, introduces us to a great void, but one that has nothing unlimited or indefinite about it, since it takes a geometric form and is easily measurable by the eye. So also in Hagia Sophia, although it yields to the late classic tendency to split the major units into smaller parts, and thus has subdivided its space, one sees the minor units merge into greater, and these into the final dominance of the central cupola, as if in a swelling crescendo. The space is clearly enough defined, and readily measured by the eye. It does not merge with space without, for the window-lighting is restrained and decorative, the architect being concerned with spots of color rather than with illumination.

The interior of Hagia Sophia thus lacks that suggestion of the unlimited which marks the really mediæval building east or west. One finds this only in later Byzantine archi-

Nave and crossing, San Pietro in Vaticano, Rome. Renaissance sixteenth and seventeenth century. Architects, chiefly Bramante, Michelangelo, and Maderna.

tecture, when the multiplying of the domes and the breaking-up of the interior into small equivalent units destroyed the old Greek proportion and unity in favor of an oriental indeterminate pattern. When this is done, as in St. Mark's at Venice, there is no contradiction between the wealth of color and the composition of the interior; both alike baffle the mind and intoxicate the eye. Such interiors are wholly Byzantine. Hagia Sophia is half Byzantine and half classic; in it a Hellenistic interior is veneered with oriental ornament.


Interior mosque, Cordova, Moorish eighth to tenth century.

But how beautifully the two elements here exist together! And how wonderfully has Anthemius made these flat surfaces, devoid of the arresting projection of classic entablatures or sculptured reliefs, subserve his purpose of making his dome both vast and light. One can see what he avoided by looking at a Renaissance interior, where the size and decoration of the supports are so prominent that the dome loses scale and is dwarfed in comparison, while at the same time it gains weight by the very massiveness of the things that hold it up. But the dome of Hagia Sophia seems to rest on mere mouldings in the wall, and east and west the pendentives and half-domes recede from under it, leaving it, as it were, suspended in air, its forty windows twinkling like the lights of a chandelier. Nowhere in the history of architecture is there an interior at once so spacious and so logical; nowhere has the dome been poised so lightly as in this Christian church, the last creation of that line of clear-thinking builders whose first triumph was the Parthenon.

NOTE.—The new material embodied in this and the preceding article on the history and construction of Hagia Sophia is borrowed from the Greek work in three volumes recently published by Antoniades. A revised and condensed version of this work in English will be brought out in the near future by Professor Emerson Swift, of the University of Michigan, to whom I am much indebted for help in the preparation of these articles.

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# Competition for the Travelling Scholarship of the Alabama Marble Company

Under the Guidance of the Committee on Education of the American Institute of Architects

## A SMALL BANK

*General:* On a lot 54 feet by 125 feet, surrounded on two short and one long side by streets, it is proposed to erect a one-story bank. As all three streets are equally important, the entrance may be on either the short or long side. The bank is the leading financial institution of the community, and wishes its building to proclaim that fact through elegance of design and use of beautiful building materials. The interior especially should have the charm, distinction, and elegance that come from the appropriate use of various marbles. The interior walls, bank screens, and floor are to be of marble, sleected, designed, and combined to produce an effect of great beauty and refinement.

*Requirements:* On the first floor there shall be provided a central space for the public, twelve to sixteen wickets; ladies' room and toilet; officers' space and toilet; directors' room; and work space; vault 8 feet by 12 feet; access to safety deposit in basement.

In the basement will be employees' locker and lunch rooms, book vaults, safety-deposit vaults, and machinery.

*Drawings required:*

Plan of first floor............scale $\frac{1}{8}$ inch=1 foot
One elevation...............scale $\frac{3}{16}$ inch=1 foot
Longitudinal section.........scale $\frac{1}{4}$ inch=1 foot
Interior details.............scale $\frac{1}{2}$ inch=1 foot

The plan, elevation, and section shall be on one sheet 27 inches by 40 inches; the interior details on another sheet 27 inches by 40 inches. The interior details may be in color and shall have a key to the kinds of marble used.

The basement need not be shown on section.

*Regulations:* 1. All drawings shall be in ink: elevation rendered with shadows cast at 45 degrees.

2. Each competitor shall certify in writing that the drawings submitted by him have been made entirely by him and such certification shall be enclosed with the competitor's name and address in a sealed envelope.

3. All drawings shall be submitted anonymously, without any mark of identification, and with the name of the competitor in an opaque sealed envelope.

4. The drawings shall be shipped or delivered, prepaid, in a stiff tube, to Walter D. Blair, No. 154 East 61st Street, New York City, not later than August 15, 1923. Any drawing that has a later shipping date than August 15 will not be entered in the competition.

5. A violation of the programme will make the competitor "hors concours."

*Judgment:* The judgment will be held about September 1, 1923.

*Jury:* The jury will consist of:

Mr. Donn Barber, of New York City, representing the Educational Committee.

Mr. Burt Fenner, of New York City.

Mr. Paul Cret, of Philadelphia.

Mr. Abram Garfield, of Cleveland.

Mr. R. Clipston Sturgis, of Boston.

*Winner:* The winner of the competition will sail for Europe about October 15, 1923.

# Sir Christopher Wren and the United States

*By David B. Emerson*

MUCH is being written just at the present time of Sir Christopher Wren, and the general public will probably receive its first knowledge of the outstanding genius of English architecture two hundred years after his death. At the same time the architectural profession in the United States will probably learn more of the man whose influence dominated the great bulk of the architectural work of the American colonies in the eighteenth century, and is a great source of inspiration even to-day.

Christophorus Wren Eques. Ædificiorum Regalium per totam ANGLIAM
Præfectus. Basilicæ PAULINÆ. Templorum, Operumq; Publicorum Urbis LONDINENSIS
Post fatale Incendium. A.D.ni MDCLXVI. Architectus, Curatorq; Generalis.
A.D. 1711. Æt. 81

CHRISTOPHER WREN.

*From a mezzotint engraving in the possession of Sir Reginald Blomfield, R.A., Litt.D.*

For many years, especially since the interest in colonial architecture was awakened back in the early eighties, the design of certain buildings in various sections of the United States, some of which were built years after his death, has been attributed to Wren; but with little evidence to support the claim other than vague traditions. Among the buildings which have been attributed to him are the charming little court-house in Williamsburg, Va.; Christ Church, Cambridge, Mass., and quite recently an old mansion in Belfast, Maine, has been added to the list. The likelihood that Wren ever designed a building which was to be erected in the American colonies is slight, particularly when one looks back and considers the time and the condition. To begin with, the building impetus in the colonies really did not begin until the end of the first quarter of the eighteenth century, not one church of any size or prominence, not a public building, nor a mansion, is standing to-day which was built much before that time, and Wren died in 1723 in his ninety-first year. Again, the reader must remember that Wren was never a practising architect in that sense which we look upon practising architects to-day, but held the office of Surveyor-General of Works from the King, and practically all his work was done under royal command.

When any one considers for a moment the great mass of work done by Wren in England during his long career of about sixty years, they can scarcely believe that he had any time to devote to the designing of buildings which were to be built in the American colonies.

Even with all of our improved methods and modern improvements, there have been very few, if any, modern architects practising alone who have turned out anything like the volume of work which is accredited to Wren, in the days when trained office assistants did not exist, and when there were no methods known for the reproducing of drawings nor the various other short cuts of present-day practice. When the output of some of the great figures of the seventeenth century, Wren, Rubens, Rembrandt, and others, are taken into consideration, one must indeed marvel that men could possibly be so prolific in their work. Of course, we all know very well that they had numerous students and assistants to aid them in their work; but, in addition to their regular work, Wren also found time to be a member of Parliament and to devote some of his time to his scientific pursuits, and Rubens accepted several diplomatic missions.

As hard as it may be for us to abandon any of our pet beliefs and to give up ideas which have been fondly cherished for any length of time, it is safe to say that we must all abandon the notion that there is one single building anywhere in this country with which Sir Christopher Wren had any direct connection with the design, or in which his distinguished protégé and colaborer, Grinling Gibbons, ever did any part of the wood-carving. Despite the fact that beyond the shadow of a doubt Wren did no work in this country, still the fact remains that his influence can be found in practically all of the best of the mid-eighteenth-century work from New Hampshire to Virginia, and although he did no work in the colonies, in all of the best work that was done in the colonies can be found that ineffaceable stamp which his genius and individuality put upon all the English architecture of that time.

# Editorial and Other Comment

## *James Gamble Rogers on the Education of the Architect*

IN a recent number of the New York *Tribune*, Young Boswell, who goes about interviewing folks for the delectation and instruction of that paper's readers, happened into the office of one of the country's foremost architects. He had a talk with James Gamble Rogers, the designer of the beautiful Harkness Memorial at Yale and other notable buildings. The topic discussed, or rather the topic upon which Mr. Rogers talked, was the education of the architect, the opportunities for the student to acquire a knowledge of his profession in this country. Nowadays, he said, a young architect can get as good training here as he can abroad, because the Beaux Arts Society gives the same training as the Ecole des Beaux Arts in Paris, with two distinct advantages. The subjects given in the programme here are more nearly related to the work that an architect will have to perform when he practices or that the student will have to work on when he enters an office. The other advantage is that the judgments as made at the Beaux Arts Society are made by practicing architects from all over the country.

Here is Mr. Rogers's idea of what a school of architecture should be:

"A school of architecture should be a school of design and have no course in engineering. The spirit of architecture, properly taught, would satisfy the necessities of engineering. The calculations have to be made by an engineer in actual practice. The architect confines himself to the design. In other words, you would be teaching what really happens in practice. In the perfect school I would have the students learn to do all their work freehand, because the architect makes his studies freehand. Probably he draws them up with T square and triangle, but he restudies them freehand. Therefore to make the best designs the student should be thoroughly taught freehand drawing. An architectural school should be part of a great university, and a large part of the work should be to teach, in some form or other, something of art and architecture to the students of the entire university. After all, art is the best recorded history of the world and its progress. It would be of great benefit to the student, making him observant, for the greatest fault with university-bred men is that they are not observant. Furthermore, their study of the arts would help to make more livable, more beautiful, and happier our everyday life, adding to it a certain charm and grace and happiness, where now it is only painful and material and practical."

Mr. Rogers is himself a man with a Beaux Arts training, and he knows whereof he writes. He does not overlook the great inspirational value of a French training, particularly in the opportunities offered for becoming familiar with Old World architecture and the freedom from distractions.

His point of view regarding the study of architecture is in harmony with that of the teachers of art in general. There seems no longer any need of a Latin Quarter environment for a thoroughly adequate technical training.

Our schools of architecture and art have long since justified themselves.

## *Something to Be Proud Of*

ATLANTA has done a great thing on behalf of her children in building eighteen thoroughly modern, up-to-date school buildings, and she has done this by calling upon the services of eighteen of her own architects. They have given of their best, and the standard of achievement they have set may well be an example for many other cities all over the country. Atlanta's problem had become one of serious import, for the old frame schools were not only inadequate but a menace to health, and the danger from fire was little less than appalling. The new schools cover every grade, and include the very newest ideas in school administration and practical efficiency. Modern school psychology has been considered in the provision of a rest room, a quiet place for both rest and moments of salutary thinking over those little matters of conduct that are no longer adjusted by old-fashioned methods favored by the late Doctor Birch.

Moral suasion is good medicine if rightly applied, and a place where it can be administered without undue publicity is a contribution to mental sanitation.

It is remarkable that Atlanta should have been able to accomplish so much in little more than a year, to bring her entire school system up to the best standards of modern school planning. We shall publish a further group of these admirable schools in our July number.

## *The "Tribune" Up-Town*

THE old New York *Tribune* building, one of the first "Skyscrapers," with its tower, has been for many years an important landmark in the down-town Newspaper Row, and the traditions and position of the paper have been always not only a matter of local pride but as well of national and world-wide importance. The paper has held a dignified and influential place in all that concerns decent and well-considered journalism, and has kept pace with the times and the needs of a great modern newspaper. Like *The Times*, *The Tribune* outgrew the old place of publication, and has met the demands of progress in establishing itself in a great modern building entirely devoted to its own needs, embodying the most recent and approved aids to newspaper efficiency. The new building is in keeping with the character of the business it houses, and is an example of good taste and conservatism in design and structure.

### *Killing the Goose*

WE are having a building boom all over the land, and the cost of materials and of labor has been going skyward with the indications of prosperity. But there are already signs that the high costs may result in a very considerable stoppage of work with the natural result of a loss to labor.

In New York there are some significant facts pointing the way to a suspension of large projects. Columbia University has postponed a $7,000,000 development, and there have been other cancellations involving large amounts.

It would seem as if all concerned might get together and arrive at some reasonable solution of the problem.

Predictions of prosperity and a continued upward tendency of costs do not, somehow, fill our minds with the cheerful optimism that is being preached from high places.

### Transfer of Registration

THE Committee on Public Information of the New York Chapter of the American Institute of Architects has succeeded in establishing a precedent for the transfer of registration from New York State to other States through the National Council of Architectural Registration Boards. This is especially interesting to architects previously registered in New York without examination. A special examination, known as a "senior examination," has been approved by the New York Registration Board, and some of the difficulties previously encountered in attempting transfer to such States as Illinois have been overcome.

New York architects registered by exemption who have, for more than ten years as principal or active head of an office, been actively engaged in the profession of architecture should apply to the New York State Board of Examiners for what is known as the "senior examination" of the National Council of Architectural Registration Boards. Architects of less than ten years' practice may apply directly to the National Council of Architectural Registration Boards for the "junior examination" if the applicant was not registered by exemption in New York, and the regular New York examination is not accepted by the State to which transfer is desired. Both of these classes must also apply directly to the Secretary of the National Council of Architectural Registration Boards, 64 East Van Buren Street, Chicago, Ill., for the necessary blanks and forms. They should designate the State to which transfer is desired, also the date and number of their home registration, whether by examination or exemption, and the number of years of practice as above defined. The board then investigates the character and credentials of applicants, conducts any necessary examinations, and keeps the data on file for presentation to the authorities of any State in which the applicant may, at any future time, desire to obtain registration.

A fee of $15.00 (par value in Chicago) should accompany the application to the Secretary of the National Council of Architectural Registration Boards. This fee is to defray expenses in connection with the investigation and examination, and does not cover the individual State fees. A further fee of $5.00 is charged by the board for each additional State to which the documents are sent.

Those who desire further information concerning the advantages of registration through the National Council of Registration Boards should ask the secretary of that board for Circular No. 4.

### European Scholarship for the University of Michigan School of Architecture

THE College of Architecture of the University of Michigan is to have a European scholarship, through the generosity of Mr. George G. Booth, of Detroit. The scholarship will be awarded for the first time at the end of the academic year 1923–24, and will be in the sum of $1,200. The successful candidate is to be given considerable freedom in the choice of his field of work and observation abroad, and is to be selected by the architectural faculty on the basis of his total record as a student, ability in design, and fitness to do independent work abroad.

### Recommended Minimum Requirements for Small Dwelling Construction

INVESTIGATIONS by a congressional committee during 1919 and 1920 disclosed that existing building laws, through variations and inconsistencies of their provisions and through unduly restrictive or expensive requirements, were operating to prevent needed activity in the building industry. That these conditions might be remedied, a committee of experienced architects and engineers was organized by Secretary Hoover to investigate building practice and code requirements and to prepare standard building regulations based on the latest and best information, which might be recommended to cities and states adopting or revising building codes.

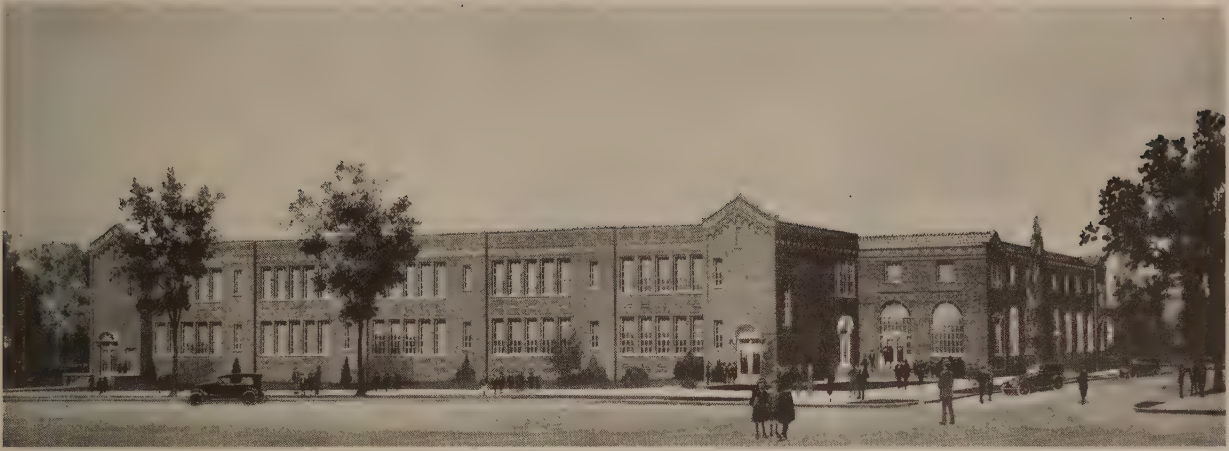
The first report of this committee presents recommendations for the construction of one-and-two-family dwellings having exterior walls of solid or hollow masonry, concrete, and frame, the latter including veneer and stucco surfaces.

In order that its recommendations might have sound bases of information and opinion the committee obtained the co-operation of nearly one hundred architectural and engineering societies, builders' exchanges, and industrial organizations producing building materials. Special questions also were referred to large groups of individual engineers, architects, building officials, to the Bureau of Standards, and to others whose experience qualified them to discuss such subjects. Tentative recommendations were drafted and submitted widely for discussion and criticism by those interested in the work, and the final report reflects the influence of this consideration.

The committee recommends that building codes permit eight-inch solid brick and six-inch solid concrete walls for two and one-half and three-story dwellings accommodating not more than two families each; that eight-inch hollow building tile, hollow concrete block, or hollow walls of brick (all rolok) shall not exceed twenty feet in height to the gables; and that frame construction be limited to two and one-half stories. Metal lath and plaster on wood studs properly fire-stopped is approved for party and division walls, but at least every alternate wall in row houses must be eight-inch solid brick or concrete or twelve-inch hollow building tile, concrete block, or hollow wall of brick.

### Convention of the American Institute of Architects

A full report of the Annual Convention, Washington, May 16, 17 and 18, will be published in the July issue of ARCHITECTURE.



(New Name) James L. Kay White Elementary School, Atlanta, Ga. Haralson Bleckley, Architect.

# The New Public Schools for Atlanta, Georgia

A. Ten Eyck Brown, Supervising Architect

THE programme of public-school building in Atlanta, Georgia, is the realization and solution of what may be justly considered the city's most vital problem. No city in the country has made a more comprehensive study of existing evil and planned more logically to lift itself from an apparently hopeless condition. In the course of a little more than one year eighteen projects for new buildings are under way, and in a comparatively short time the entire school system of Atlanta will be housed in modern, adequately equipped buildings to replace and augment the ramshackle fire-traps that have been used.

The educational engineers, Doctors Strayer and Engelhardt, of Teachers College, Columbia University, were appointed the latter part of 1921 to make a survey of the entire school system, and since that time appointed to act as advisers and experts in reference to the preparation of plans and specifications for all the projects, and have been of inestimable value in the development of the entire work, and have enabled the supervising architect and the project architects to proceed much more rapidly and efficiently than they could have otherwise done, as the requirements for each project have been developed along careful lines as to present and future requirements, and it has made it possible to design each project for its future ultimate development in complete shape, but has also made it possible to construct them, unit by unit, and provide a workable unit out of present funds for each of the eighteen projects. Their work has also made it quite feasible to complete each project on a well-studied and preconceived layout as soon as more funds are available.

Mr. A. Ten Eyck Brown was selected as supervising architect of the whole building programme, and a contract outlining his powers was signed on January 31, 1922. Eighteen firms of architects practising in Atlanta were allotted one building each.

A trip of inspection was made of school systems in the North and East by the Supervising Architect, the chairman of the Finance and Building Committee of the Board of Education, and Professor Willis A. Sutton, superintendent of schools, during the early part of March, during which a great deal of valuable information was secured.

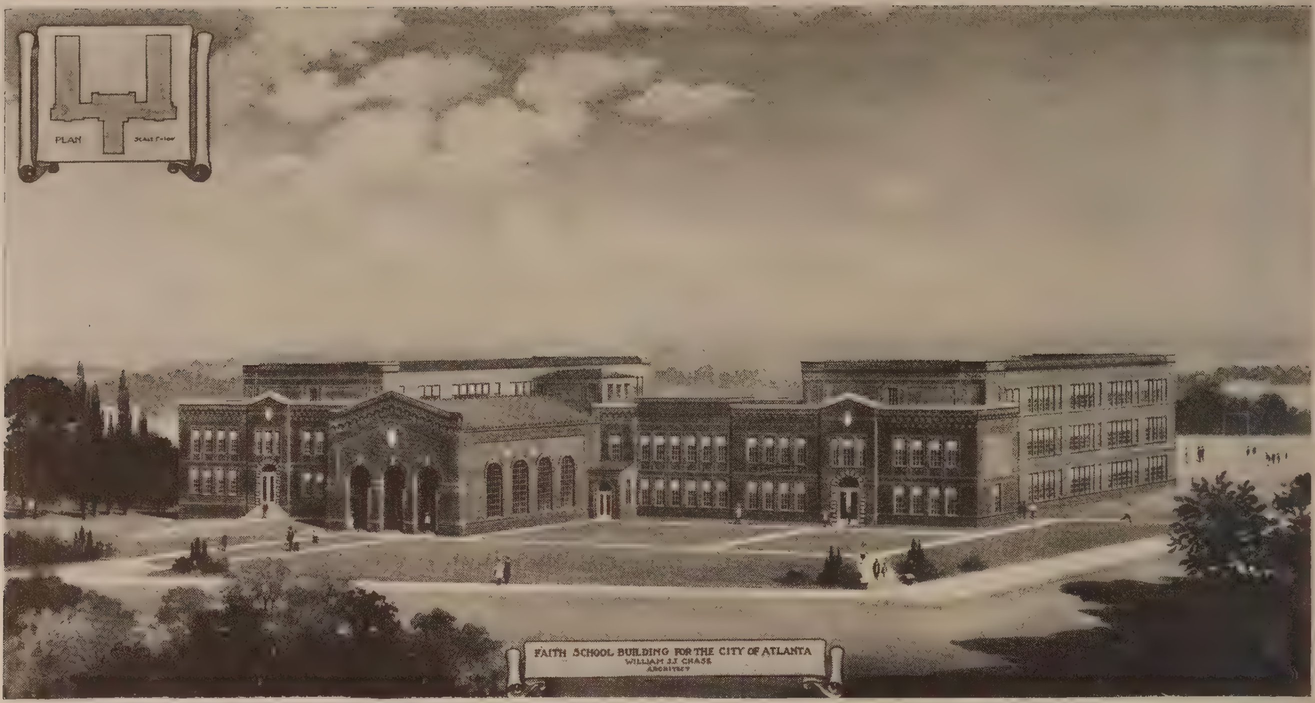
A method of operation and procedure was drawn up in reference to the preparation of plans and specifications by project architects, based upon which contracts were made with the different firms of architects covering the eighteen projects, in April, 1922.

Bids upon the first three projects, *i. e.*, Lucile Avenue addition, English Avenue addition, and East Atlanta addition, were let August 22, on the general contracts, and on the same date on the mechanical contracts.

Following the award of the contracts on the above projects, the other contracts have been let.

It is proper to draw attention to the assistance and efficient co-operation of all project architects without exception, some of whom have worked under difficulties, but all of whom have given their personal attention first to the production of their preliminary sketches, second to the production of the working drawings, and specifications, for estimates, and third to the proper carrying on of the work under standard methods prescribed, for the efficient operation of the construction work throughout, and there is no reason why this efficient assistance should not continue until the completion of all projects, not only for that part which has already been contracted for, but for the future development of all projects covered by the preliminary layouts developed under the direction of superintendents and the educational engineers.

The experience of other cities has shown that the preparation of plans and specifications, and the letting of contracts, and the beginning of construction work, on fifteen projects within approximately eight months, is very unusual. The work that is now being done, and will be done to complete this programme, is of a character which is fireproof, durable and permanent in every particular, and designed for future additions and final completion, with the idea that it will create a standard below which school-buildings in the city of Atlanta will never fall.

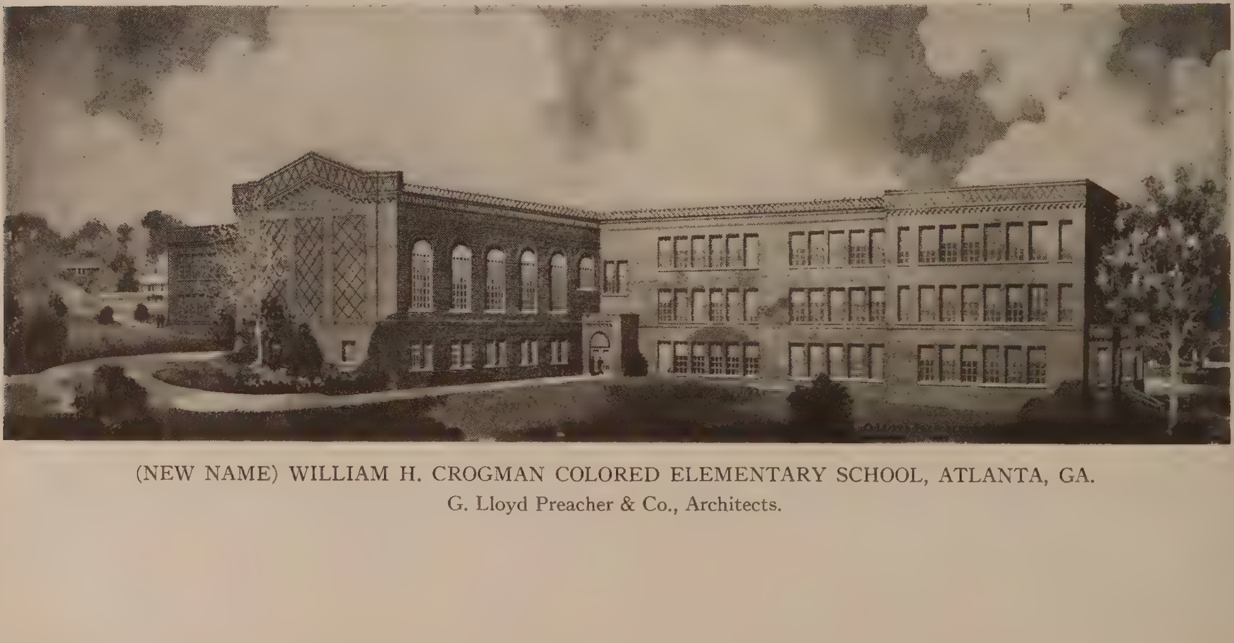

PLAN
FAITH SCHOOL BUILDING FOR THE CITY OF ATLANTA
WILLIAM J.J. CHASE
ARCHITECT

(NEW NAME) LAURA A. HAYGOOD NORMAL TRAINING SCHOOL, ATLANTA, GA. Wm. J. J. Chase, Architect.

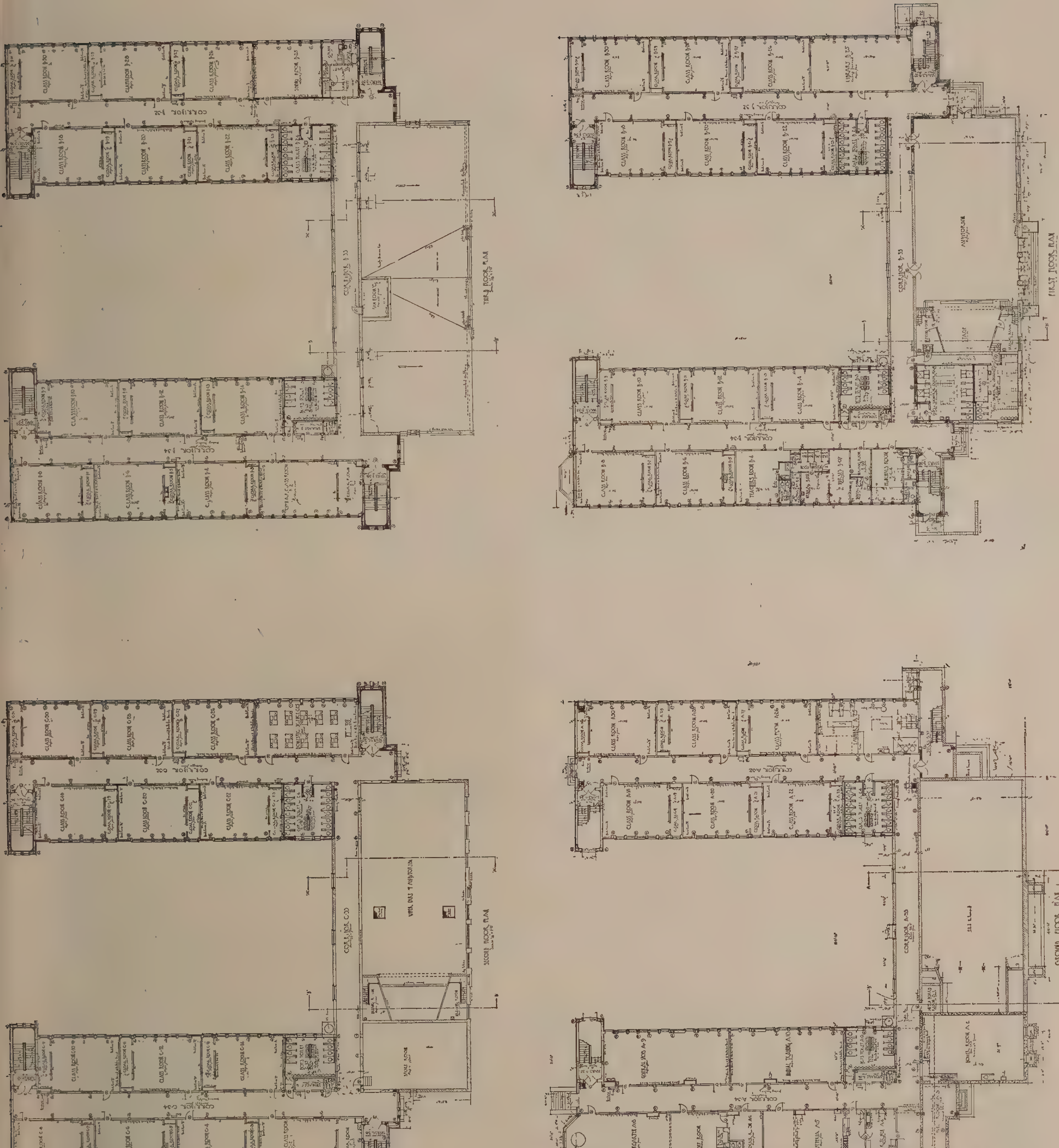
Normal school, combined with an elementary school which might be termed the "practice" department.

The elementary school has thirty-two standard classrooms, two open-air classrooms, four special classrooms, kindergarten, industrial arts department, domestic science department, containing a model housekeeping apartment, laundry, etc., library, teachers' rest rooms, cafeteria, auditorium, gymnasium, lockers, and shower-rooms, administration offices, medical and dental clinics, etc. The normal department contains four large classrooms, with two adjoining practice classrooms to each, normal laboratory, arts and crafts department, industrial arts drafting-room, lunch-room and kitchen, administration offices and library.

The perspective shows a future extension of one floor on each of the two rear wings; this space is not included in the above nor is it contemplated in the present building programme, though cared for structurally. On a site 400 feet by 850 feet the building is admirably situated for its purposes. As in all other schools of this building programme, the building is fireproof, reinforced concrete floor system, steel sash windows, wire glass smoke-screens to all stair-towers, etc., the only wood used in the construction being the corridor doors and frames, finish floor of classrooms, and a wood baseboard. The heating and ventilating systems consist of direct heat with fan exhaust.

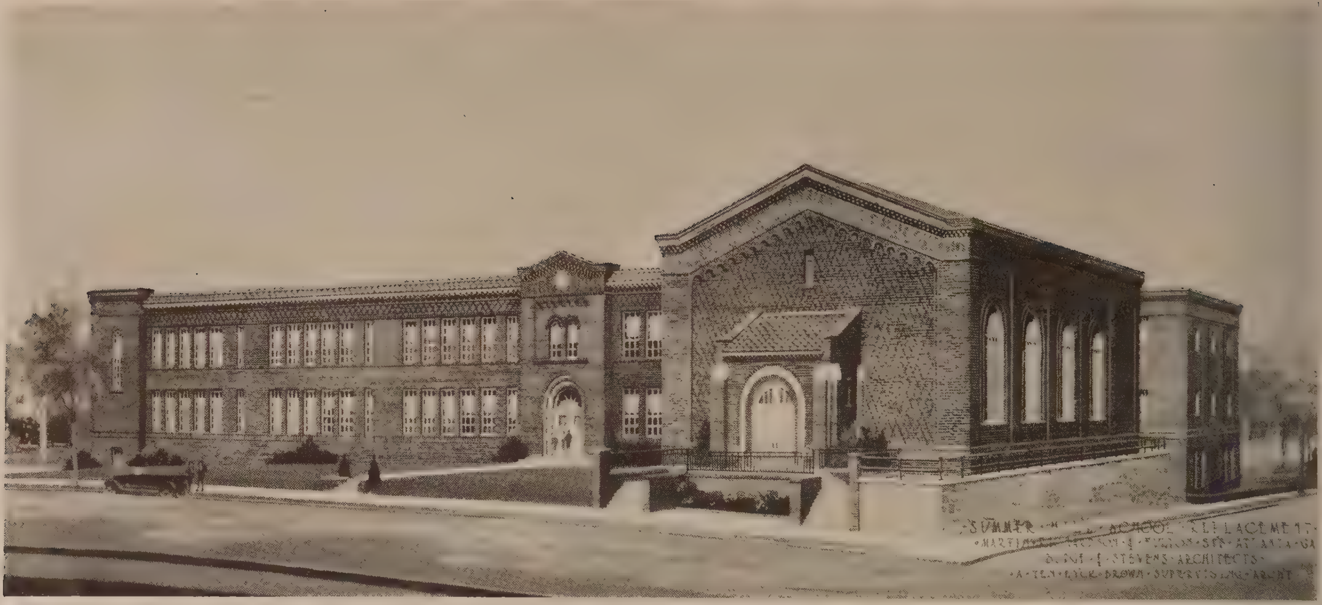


(NEW NAME) WILLIAM H. CROGMAN COLORED ELEMENTARY SCHOOL, ATLANTA, GA.
G. Lloyd Preacher & Co., Architects.



PLANS, DAVID T. HOWARD COLORED ELEMENTARY SCHOOL, ATLANTA, GA.

A. N. Robinson, Architect.


SUMNER [illegible] SCHOOL REPLACEMENT
MARTIN [illegible] & FULTON STS ATLANTA GA
BURGE & STEVENS ARCHITECTS
A TEN EYCK BROWN SUPERVISING ARCHT

(NEW NAME) EDWIN P. JOHNSON COLORED ELEMENTARY SCHOOL, ATLANTA, GA. Burge & Stevens, Architects.

The problem in this section of the city, as was the case with all colored sections, was a problem of adequately housing the maximum number of students with the least possible cost, consistent with good design, convenient and comfortable arrangement, and scientific lighting, heating, and ventilating.

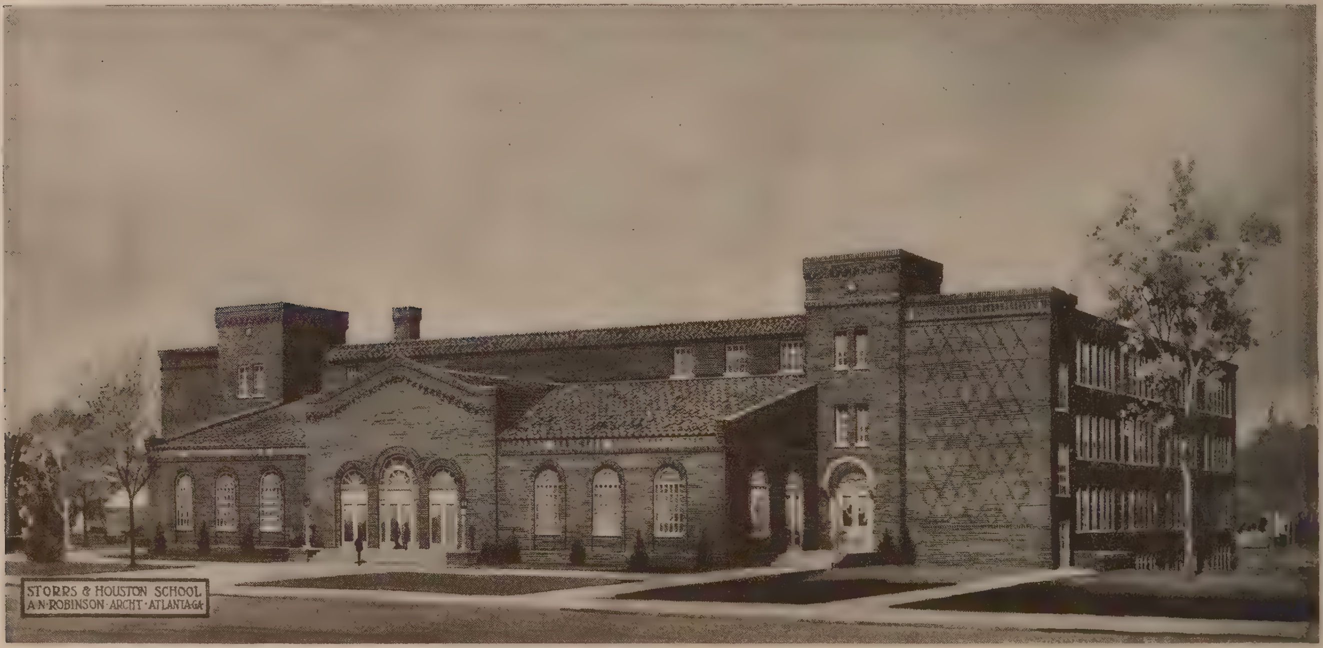
Owing to the limited amount of funds available, all ornament and expensive building materials were cut to a minimum, but in no case was an inferior type of construction or an inferior grade of materials used.

In order to afford the maximum efficiency in lighting and ventilating, the ultimate scheme contemplates three parallel wings running north and south and facing east and west, connected along the axis of the main entrance by circulation corridors at each floor. As shown in the perspective, an auditorium capable of seating eight hundred was placed on the southwest corner of the property, in order to enable it to answer a very urgent requirement of a community meeting-place for the colored people of the section.

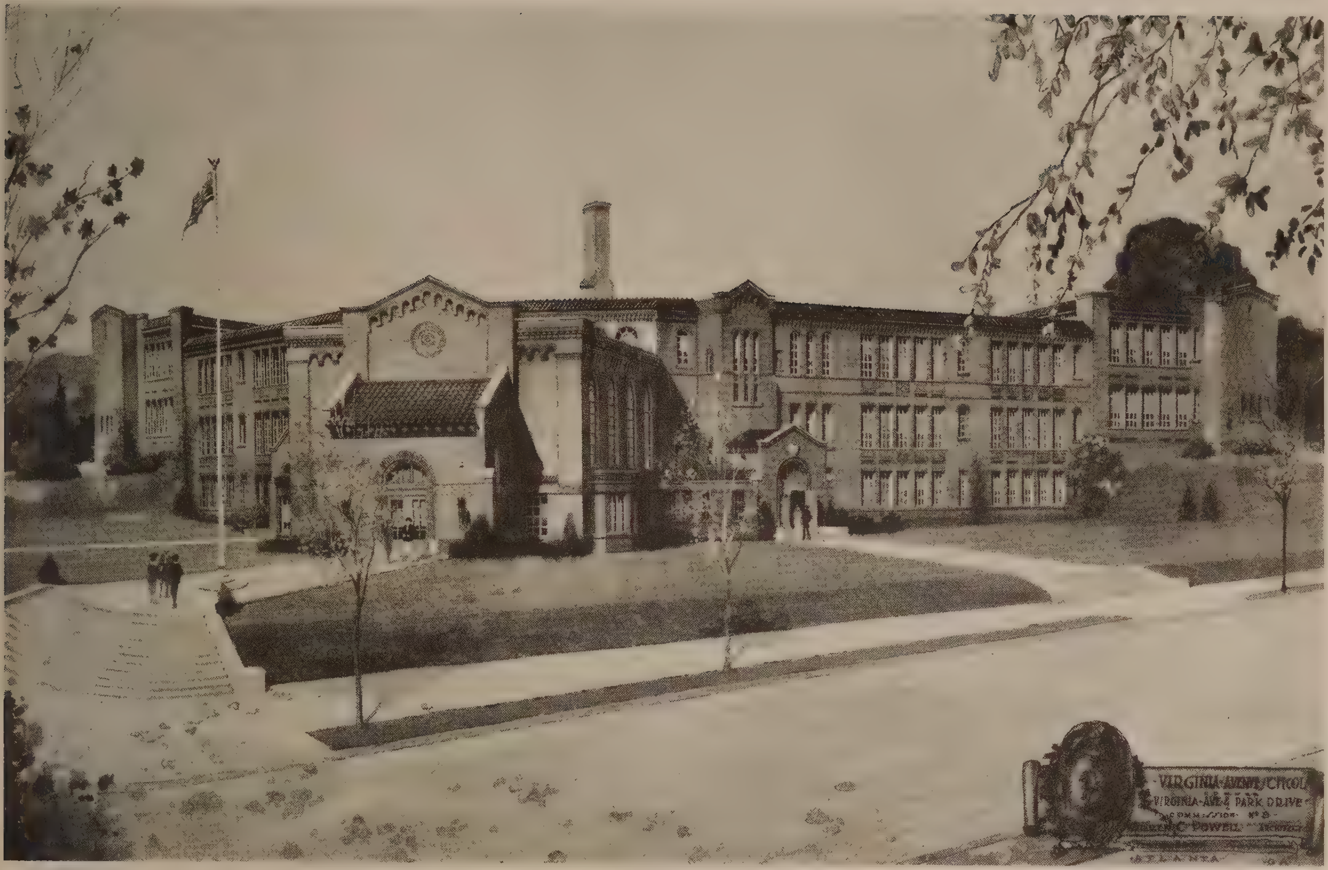
The school ultimately contemplates an outlay of twenty-four classrooms with proper toilet and cloak-room facilities, a large kindergarten unit with separate entrance, laundry and domestic science departments for the girls, wood, shop, and household mechanics department for the boys, a large cafeteria, and medical and administrative units.

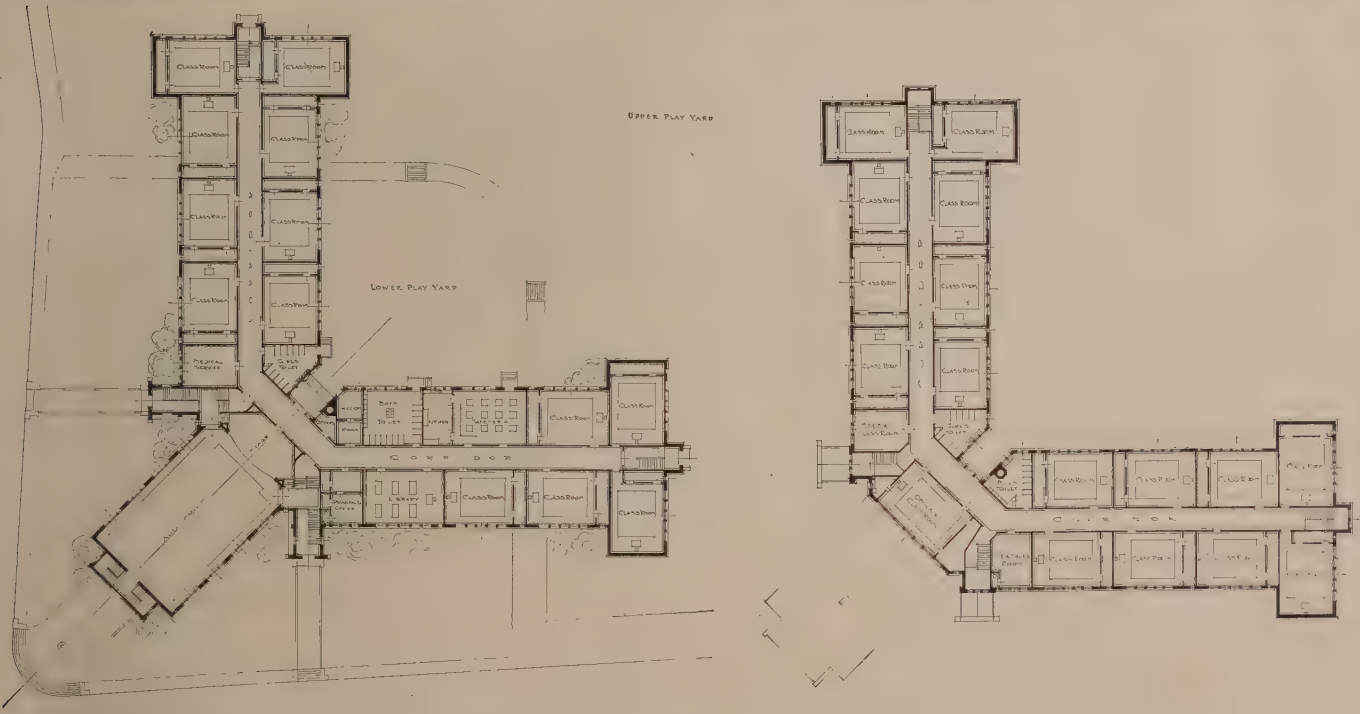
This school is to serve as a primary school, running into a junior high curriculum in the upper grades, affording a semi-junior high course for the colored students who in so many cases never attend high school. In this way, the city feels it is doing the greatest amount of good in enabling this class to get an education which naturally will make them better and more useful citizens.

As to the construction of the building, it is a type "B" construction with brick bearing walls, concrete floor, and roof slabs, steel windows, and fireproof stair-wells. In short, the design is one in which economy and utilitarian values predominate.



(NEW NAME) DAVID T. HOWARD COLORED ELEMENTARY SCHOOL, ATLANTA, GA. A. N. Robinson, Architect.

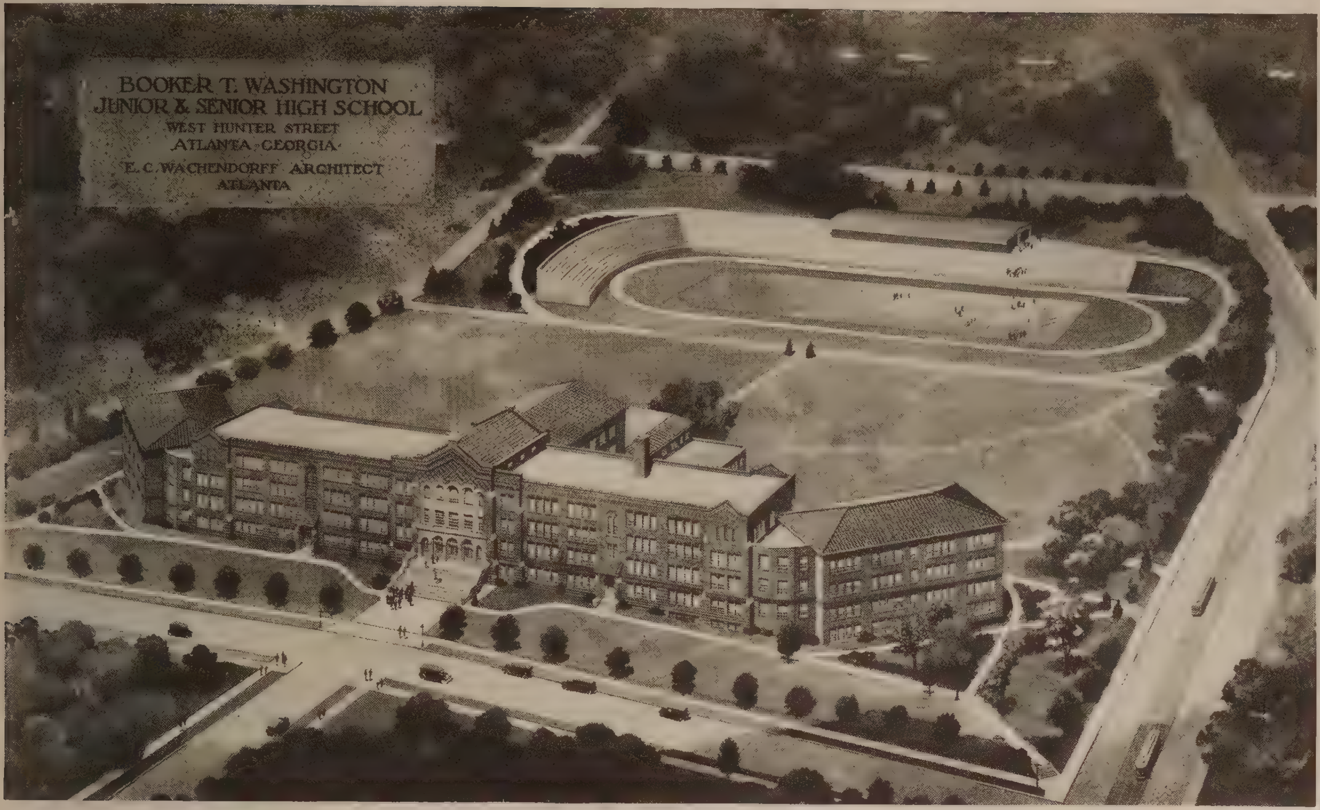


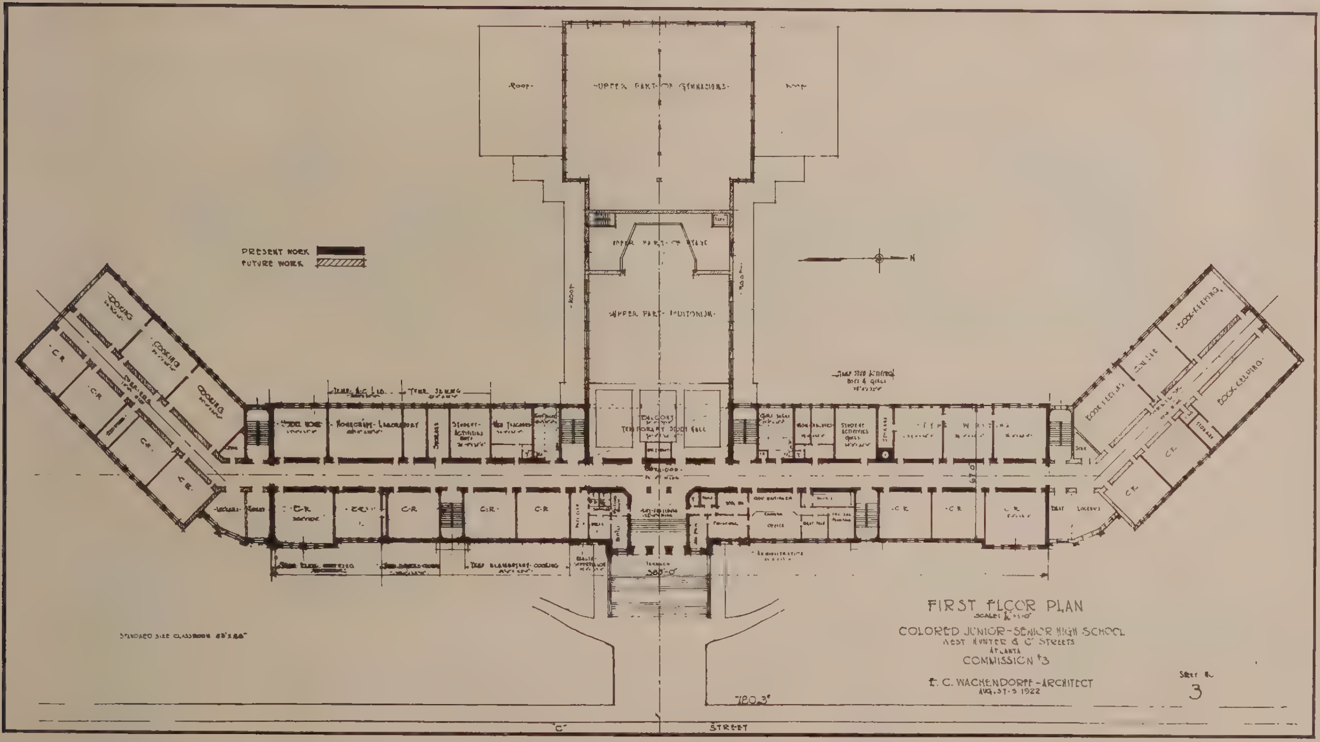


(NEW NAME) SAMUEL M. INMAN WHITE ELEMENTARY SCHOOL, ATLANTA, GA. Warren C. Powell, Architect.
The names of the schools have been changed since the drawings were made.

This lot had a forty-foot difference in grade from the lowest to the highest point before operations were commenced. The ground floor therefore is utilized only on the front, as shown in perspective, and has four classrooms in the main building, and the kindergarten and domestic arts occupy the space under the auditorium. The front of the auditorium faces southwest and, as shown on plans, most of the classrooms are on the south, east, and west fronts.

The building is entirely fireproof, the exterior is of brown brick, rough texture, with the same texture brick in red for trimmings, together with terra-cotta ornaments.



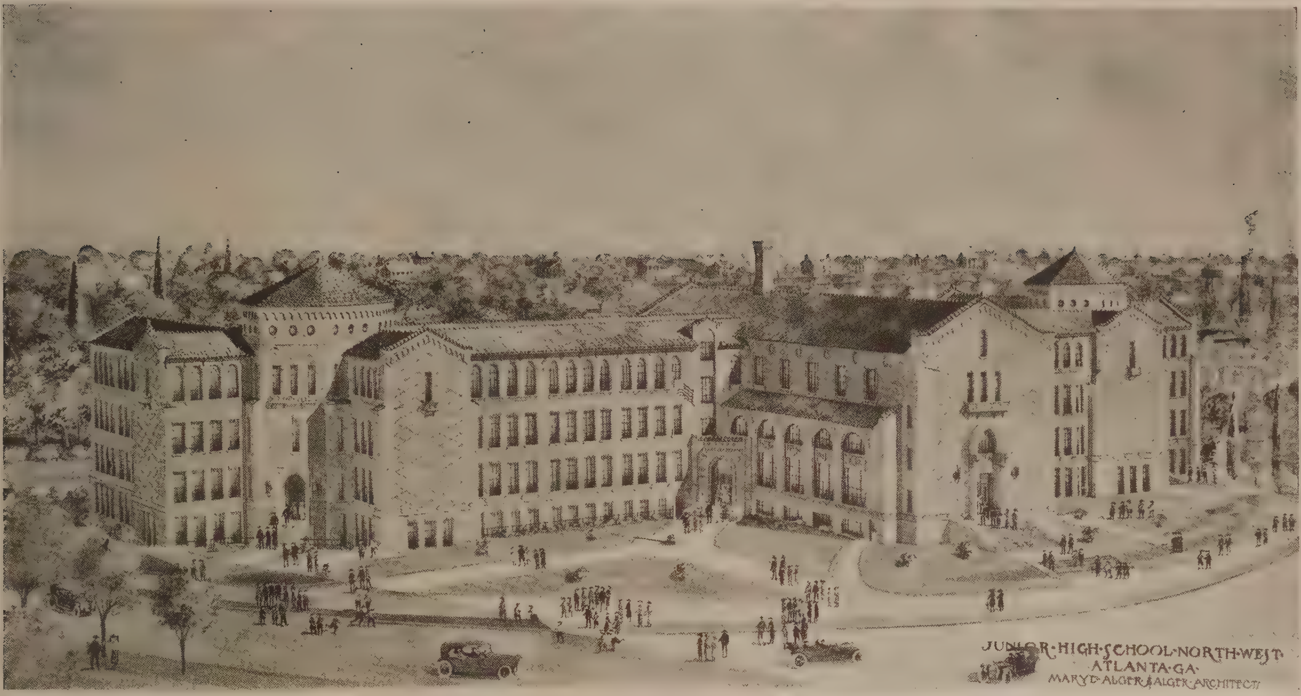


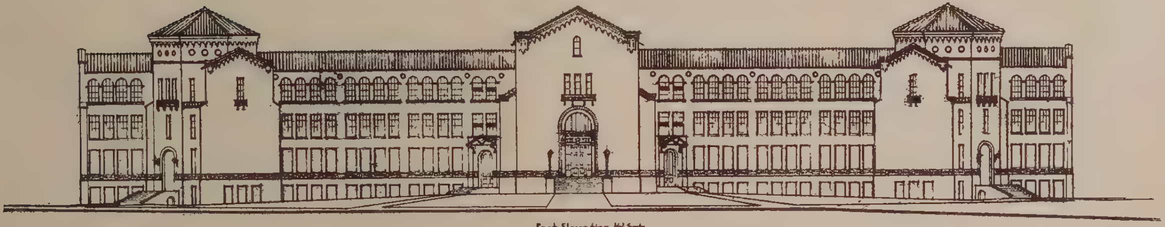
The site is a tract of land in the western portion of Atlanta, near the colored colleges, having an eastern frontage of 780 feet and a depth of 1,125 feet, or approximately twenty acres.

The ground floor is given over to industrial units. In the first floor is the administration units for day and night school, health supervision, classrooms, commercial and household arts. Second floor: library, classrooms, study halls, two biology laboratories, each 25 feet by 40 feet, with lecture-rooms between. Also two general science laboratories, with lecture-room between. Third floor: classrooms, study hall, music-room, two physical laboratories and two chemistry laboratories, each with lecture-rooms between.

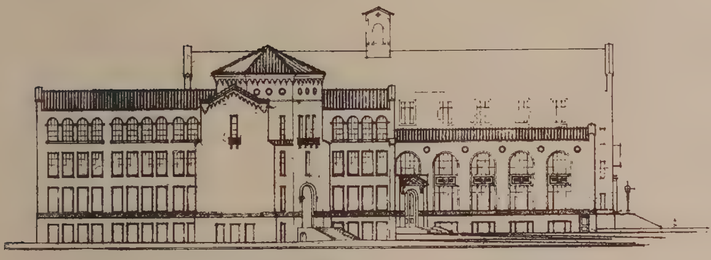
The centre front wing, that portion now being erected, will cost about $350,000, and the total cost, including the future rear and end wings and the athletic field and stadium, will represent an expenditure of $1,000,000.

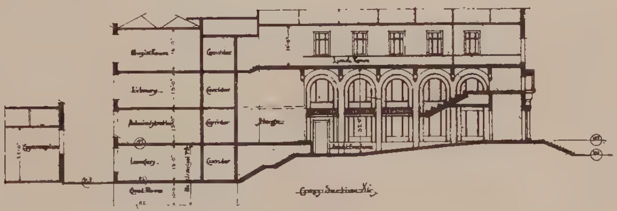
The project is of interest because it will probably be the largest public school in the country exclusively for the use of colored children.


JUNIOR·HIGH·SCHOOL·NORTH·WEST·
ATLANTA·GA·
MARYE·ALGER·&·ALGER·ARCHITECTS


East Elevation 1/16" Scale

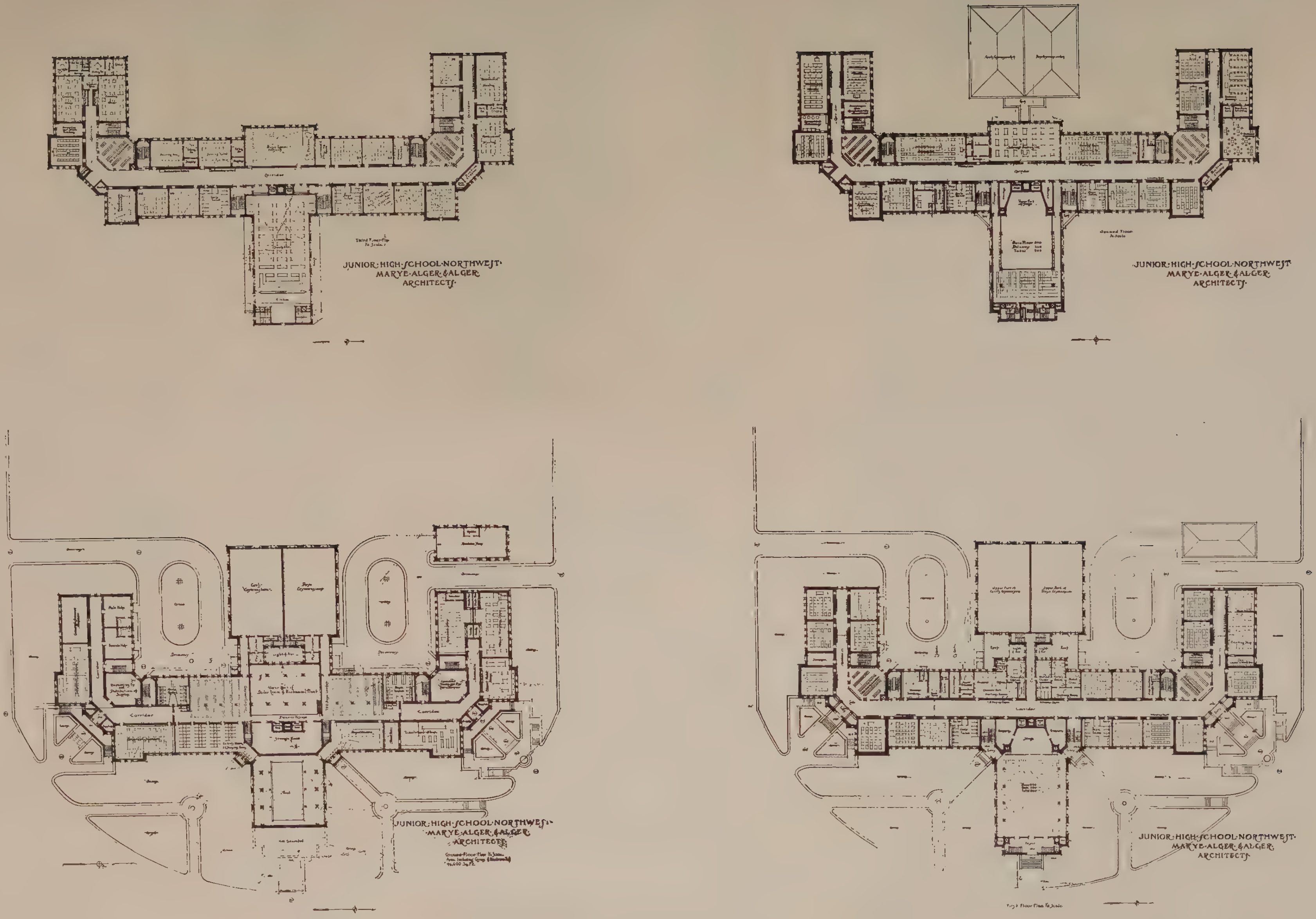
JUNIOR·HIGH·SCHOOL·NORTHWEST·
MARYE·ALGER·&·ALGER·
ARCHITECTS·


South Elevation 1/16" Scale



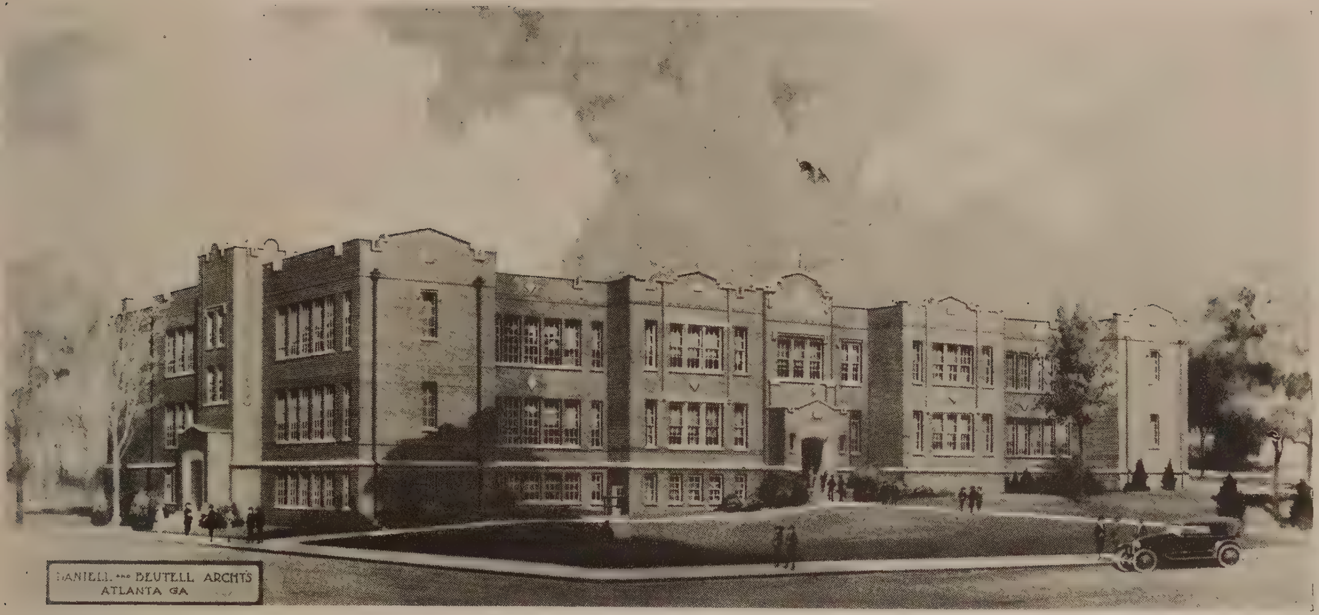
Cross Section 1/16"

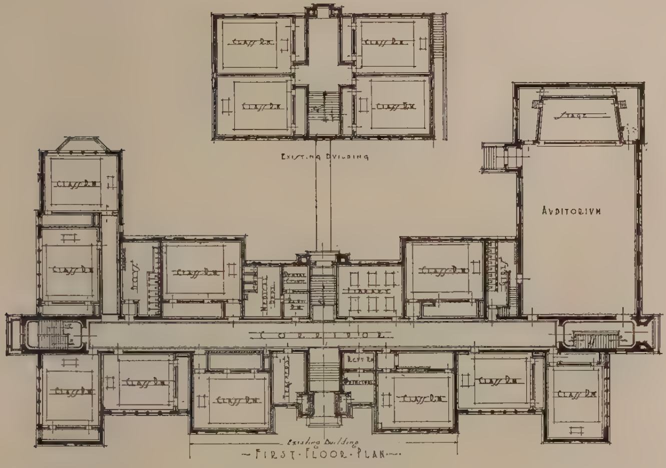
(NEW NAME) JOSEPH E. BROWN JUNIOR HIGH SCHOOL, ATLANTA, GA. Marye, Alger & Alger, Architects

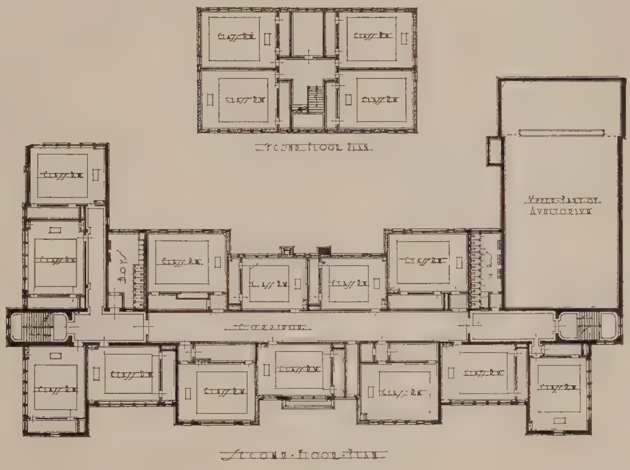


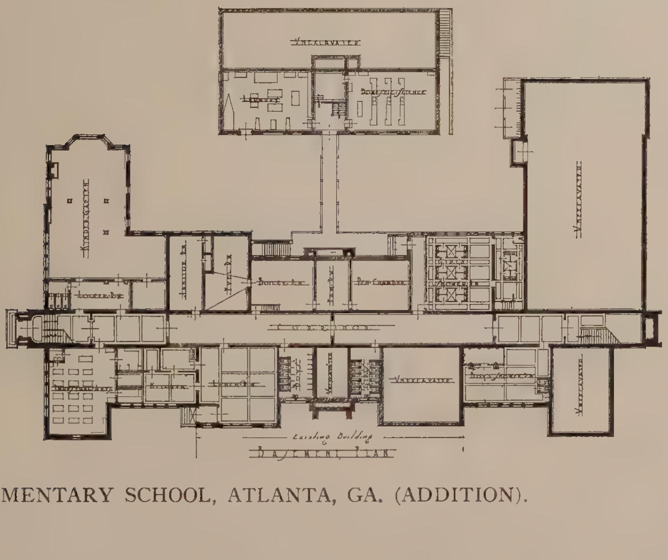
PLANS, JOSEPH E. BROWN JUNIOR HIGH SCHOOL, ATLANTA, GA.

Marye, Alger & Alger, Architects.

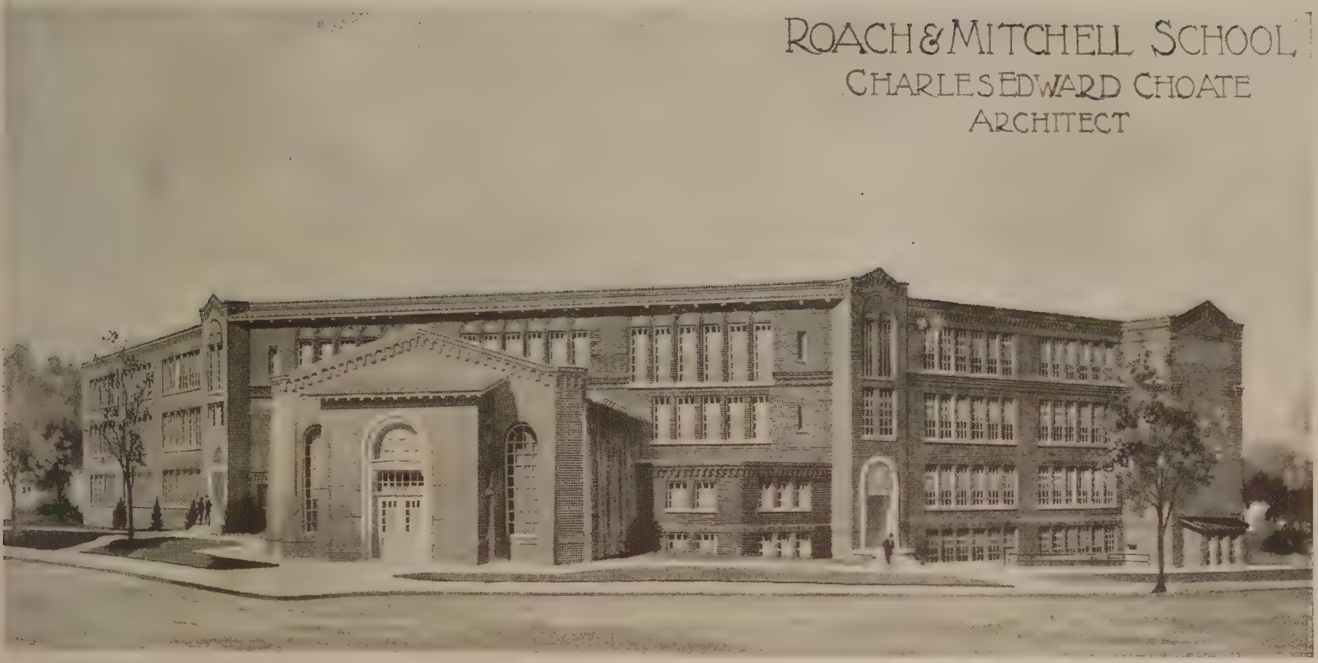


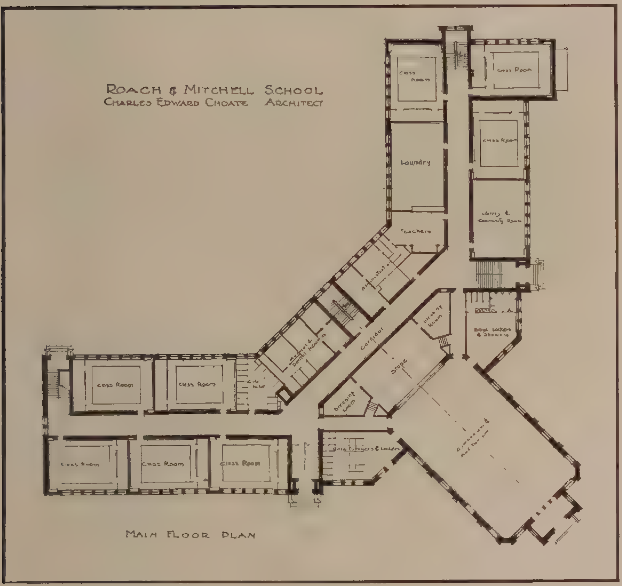


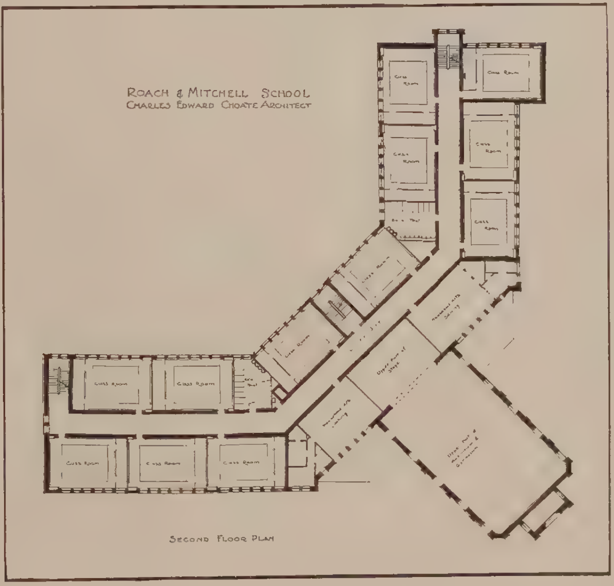




ENGLISH AVENUE WHITE ELEMENTARY SCHOOL, ATLANTA, GA. (ADDITION). Daniell & Beutell, Architects.

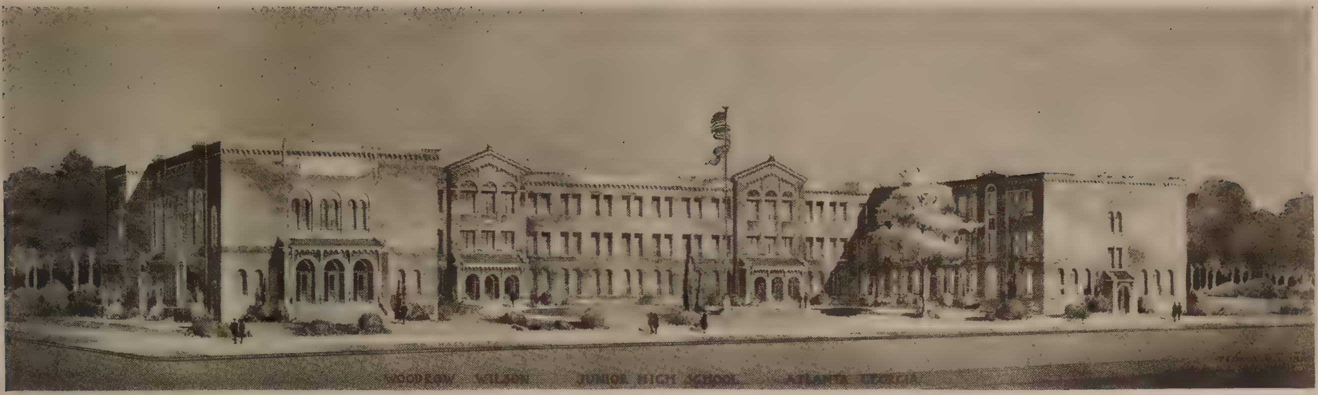


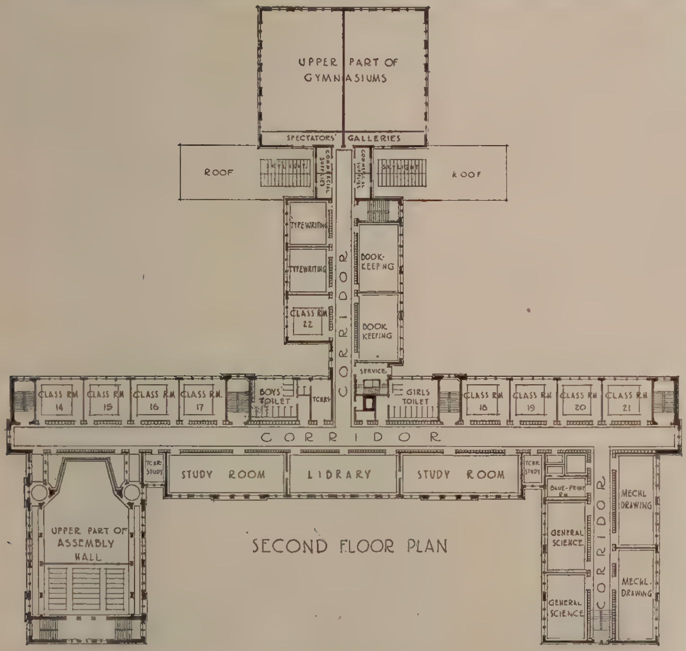


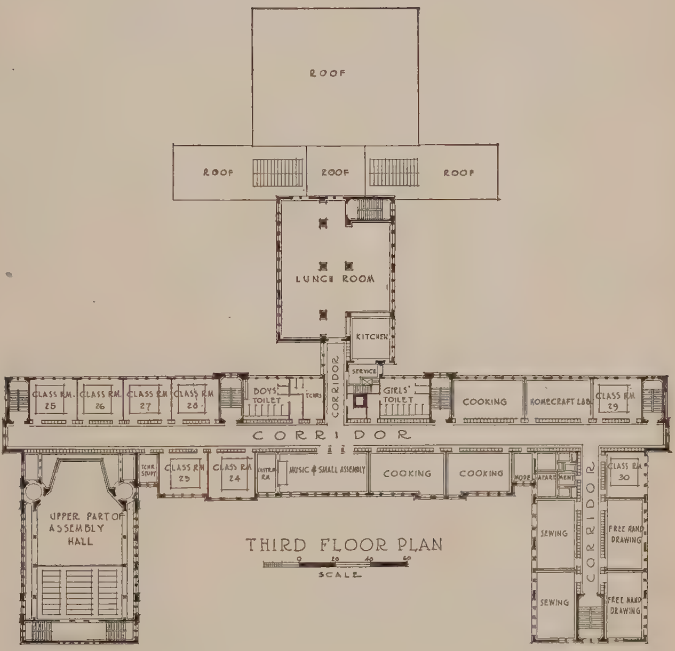


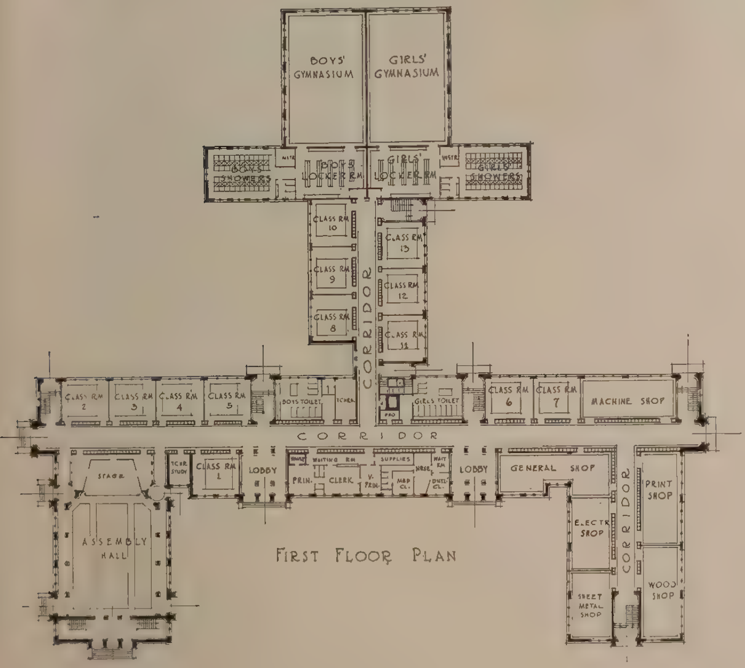
(NEW NAME) EDMUND A. WARE COLORED ELEMENTARY SCHOOL, ATLANTA, GA. Charles Edward Choate, Architect.

This is a grammar school for negroes designed to meet the requirements of approximately one thousand pupils. The auditorium and the gymnasium are combined as one unit; the heating and ventilation systems are according to the best standards; and the design of the whole is executed in the Lombardy style of architecture.


WOODROW WILSON JUNIOR HIGH SCHOOL ATLANTA GEORGIA

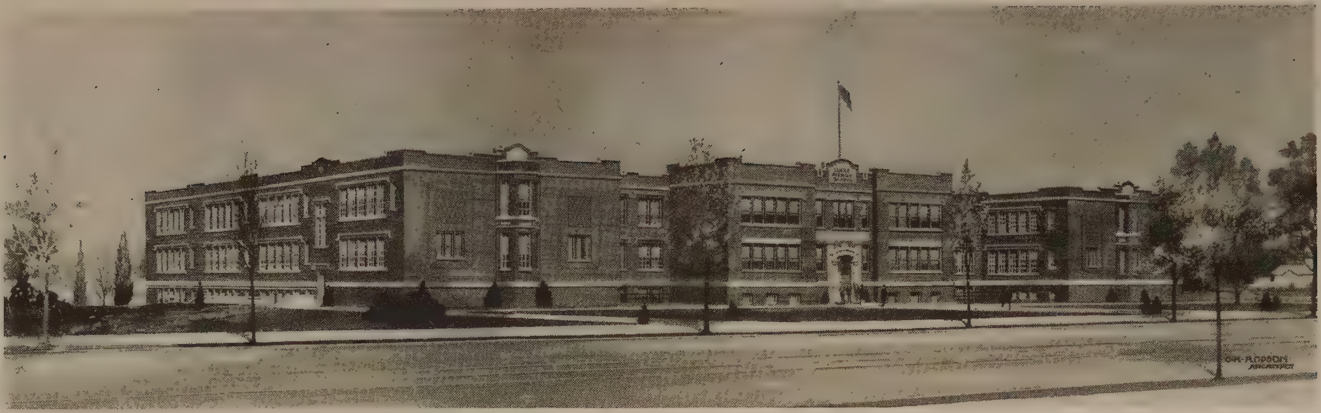






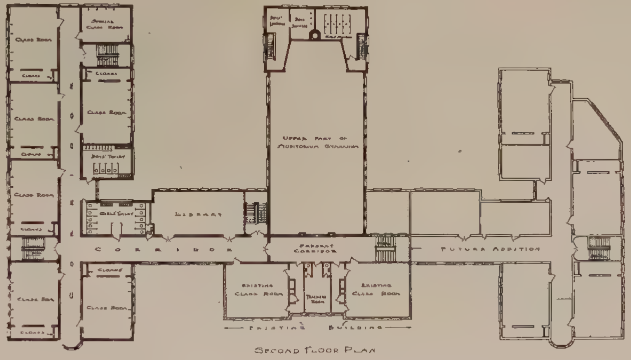
WOODROW WILSON JUNIOR HIGH SCHOOL, ATLANTA, GA.

Pringle & Smith, Architects.

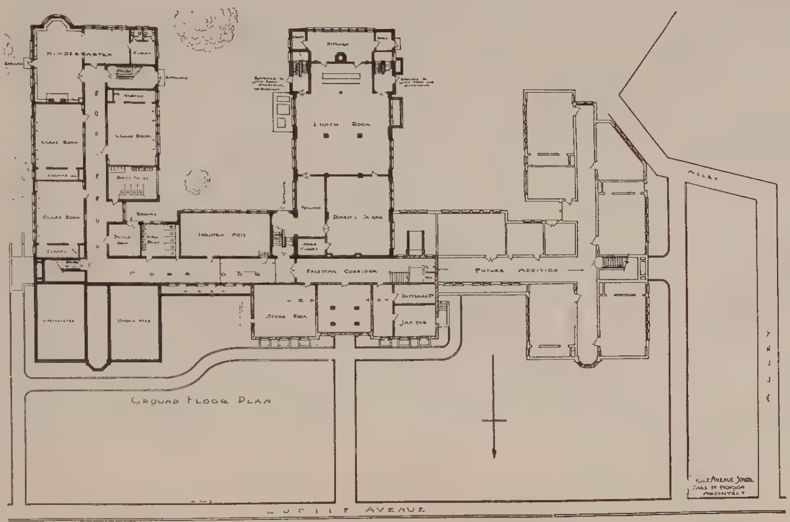


The original Lucile Avenue School is a six-classroom building of pressed-brick and wood-floor construction, and was built seven years ago for about $17,000.

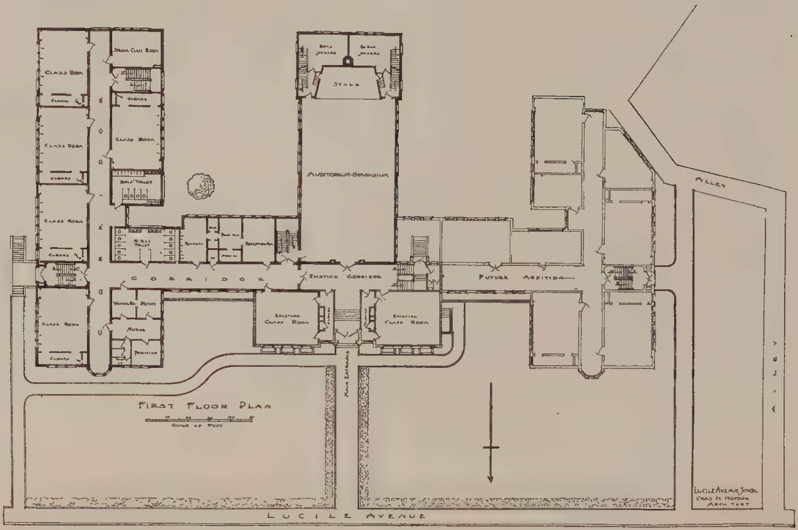
The new extensions on east and south sides of existing structure are fireproof throughout and consist of auditorium-gymnasium, domestic science department, medical and dental units, kindergarten, sixteen classrooms, teachers' rooms, dining-room cafeteria, kitchen, storage, and bicycle-rooms. The auditorium is being equipped with boys' and girls' locker-rooms and showers. Each story is supplied with adequate toilet facilities. The new work will cost $215,000, including heating, lighting, and plumbing.



SECOND FLOOR PLAN

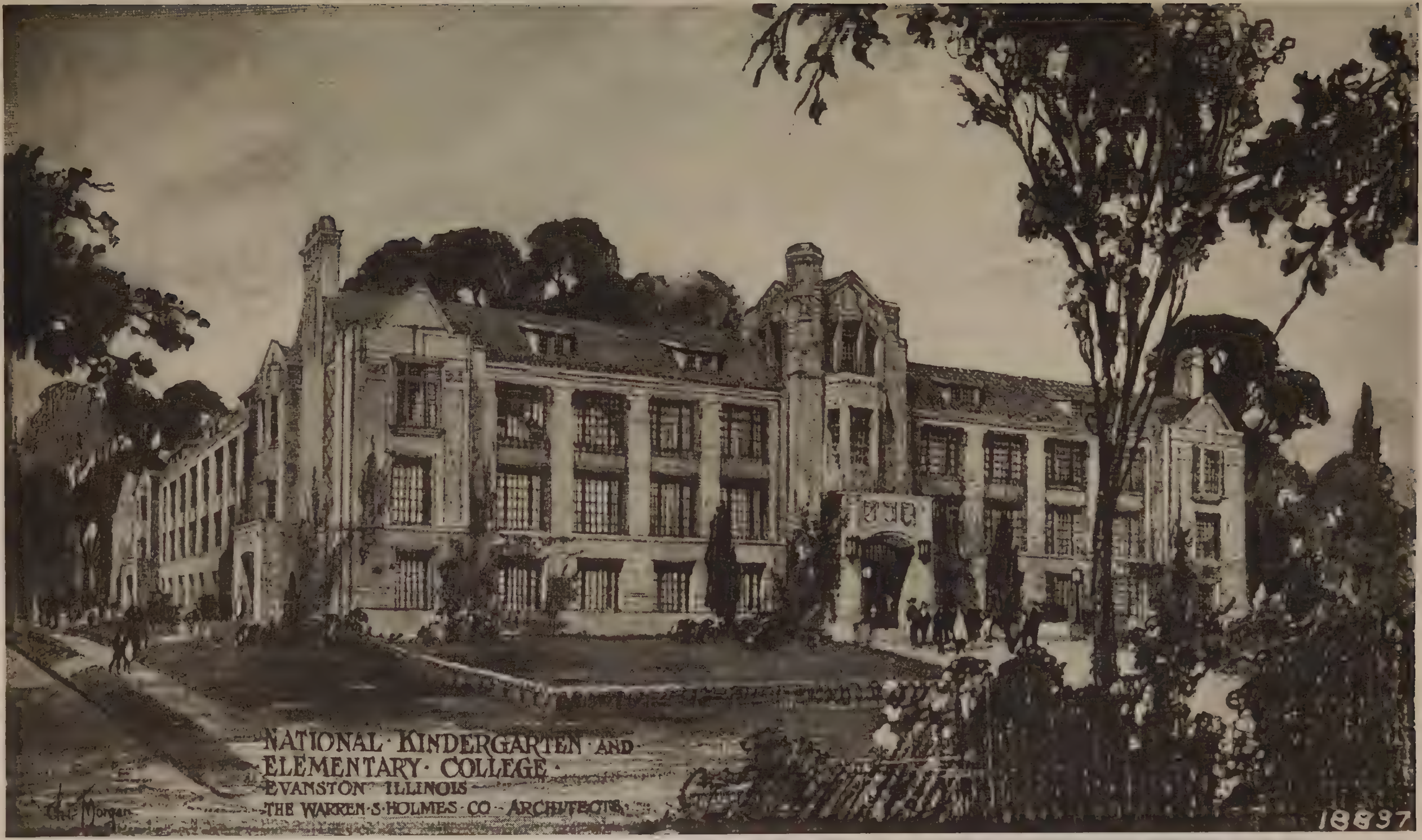


GROUND FLOOR PLAN



FIRST FLOOR PLAN

(NEW NAME) JOEL CHANDLER HARRIS ELEMENTARY SCHOOL, ATLANTA, GA. (ADDITION). Chas. H. Hopson, Architect.


NATIONAL · KINDERGARTEN · AND
ELEMENTARY · COLLEGE ·
EVANSTON ILLINOIS
THE WARREN · S · HOLMES · CO · ARCHITECTS
Chr. Morgan
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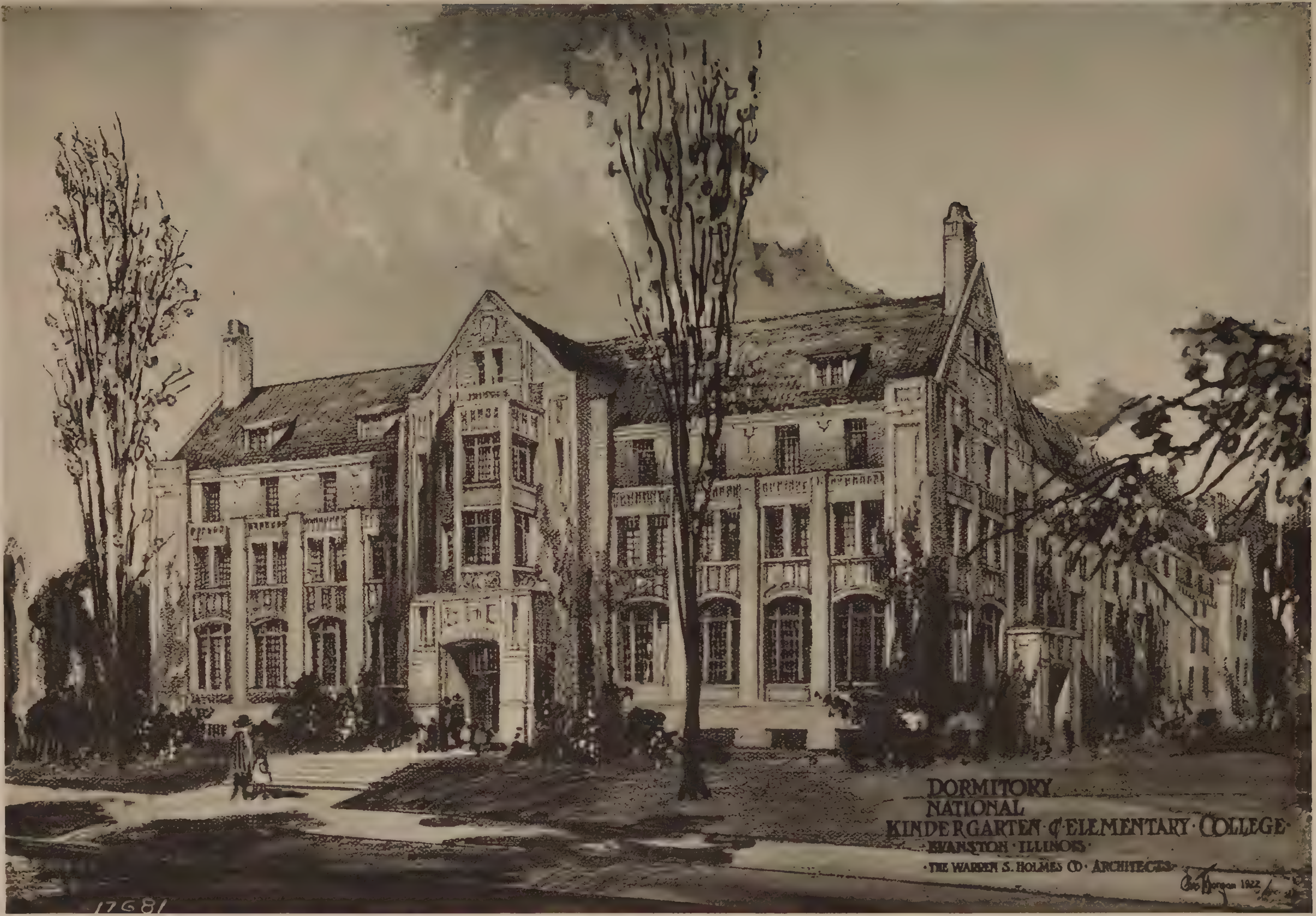
NATIONAL KINDERGARTEN AND ELEMENTARY COLLEGE, EVANSTON, ILLS. The Warren S. Holmes Co., Architects.


DORMITORY
NATIONAL
KINDERGARTEN·&·ELEMENTARY·COLLEGE·
·EVANSTON·ILLINOIS·
·THE WARREN S. HOLMES CO· ARCHITECTS·
Geo Horgan 1922
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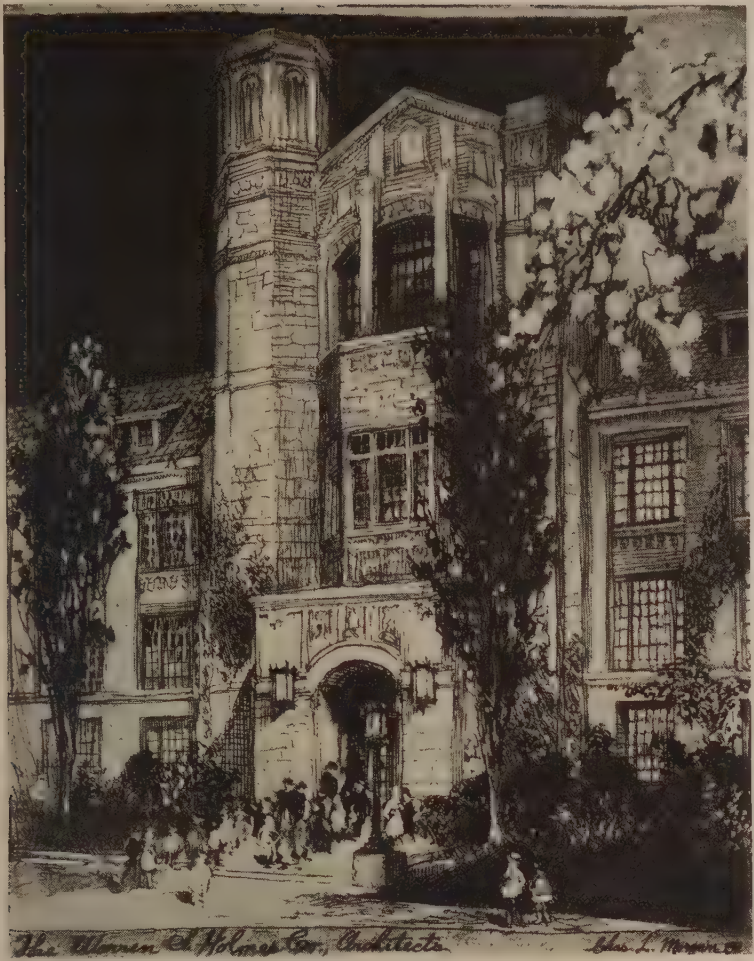
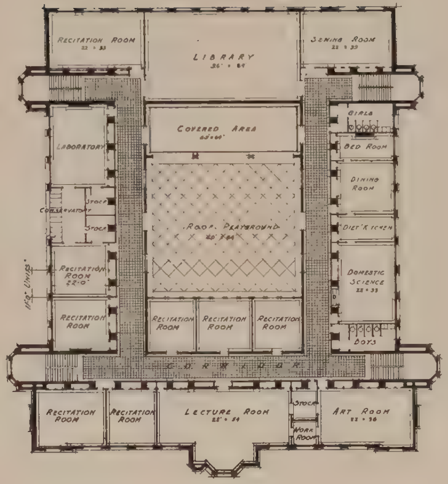
DORMITORY, NATIONAL KINDERGARTEN AND ELEMENTARY COLLEGE, EVANSTON, ILLS.

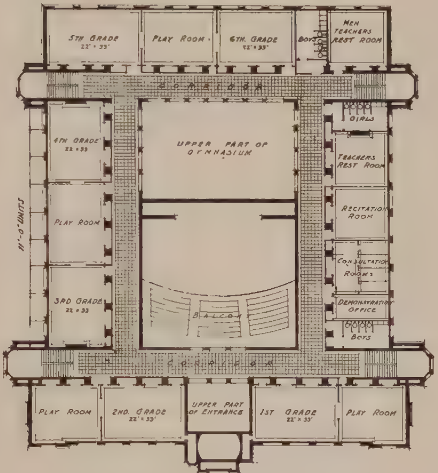
The Warren S. Holmes Co., Architects.


The Warren S. Holmes Co., Architects
Chas. L. Morgan

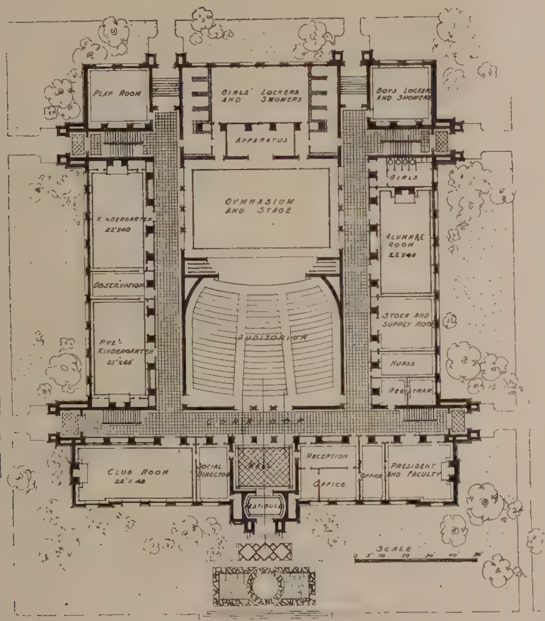
ENTRANCE DETAIL.



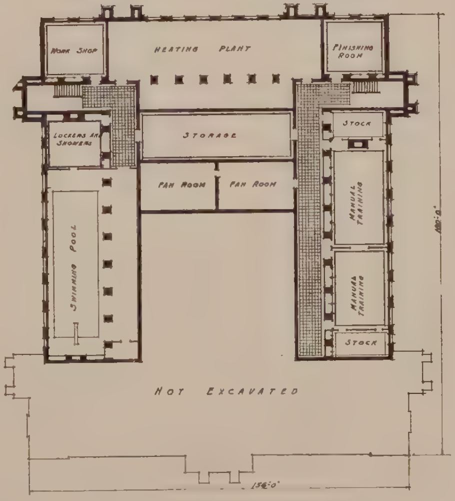
— THIRD FLOOR PLAN —



— SECOND FLOOR PLAN —



~ FIRST FLOOR PLAN ~

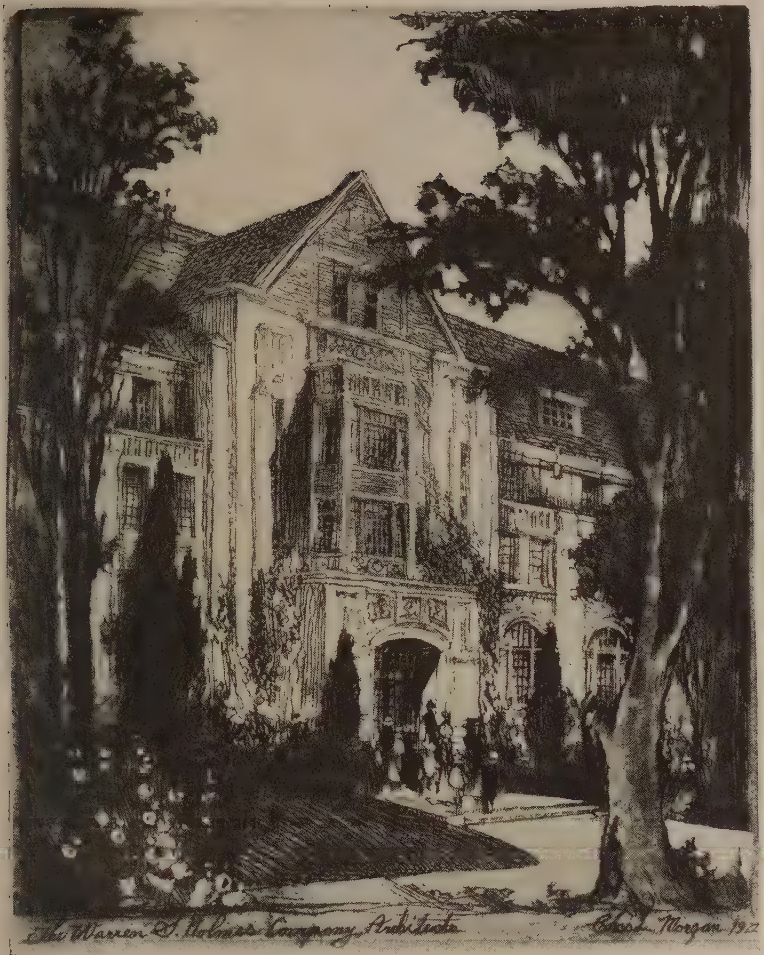


— BASEMENT PLAN —

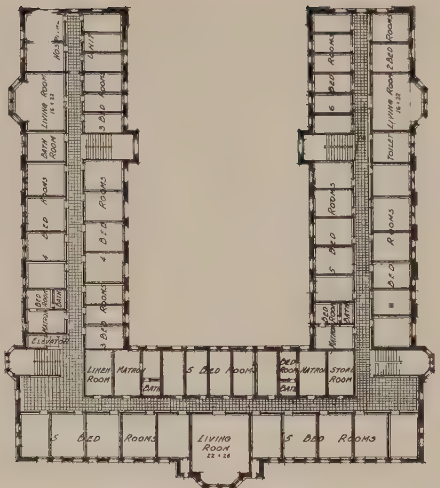
PLANS.

The Warren S. Holmes Co., Architects.

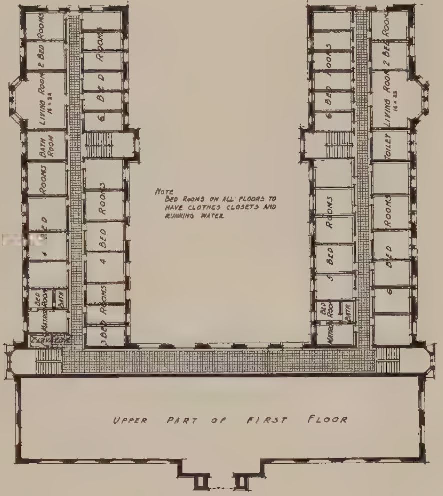
NATIONAL KINDERGARTEN AND ELEMENTARY COLLEGE, EVANSTON, ILLS.


The Warren S. Holmes Company, Architects
Chas. L. Morgan 1922

ENTRANCE DETAIL.

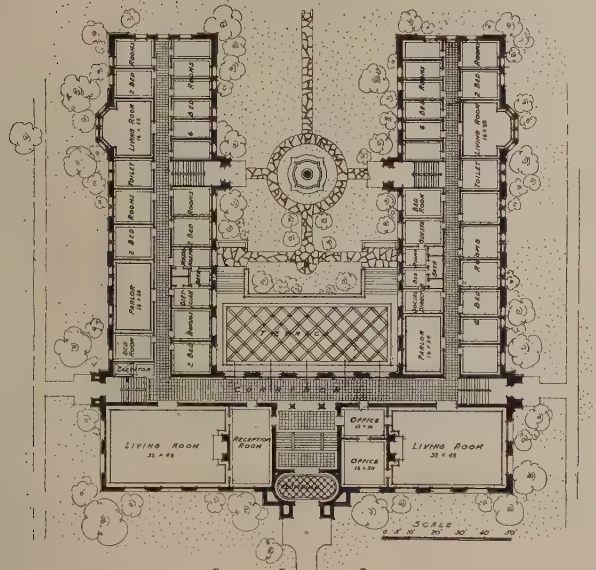


— THIRD FLOOR PLAN —
FOURTH FLOOR SIMILAR

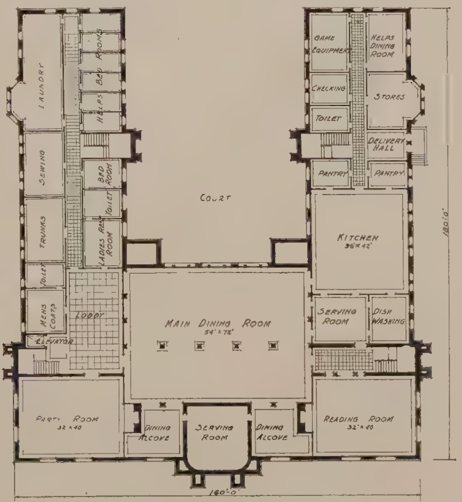


Note
Bed rooms on all floors to have clothes closets and running water.

— SECOND FLOOR PLAN —



— FIRST FLOOR PLAN —

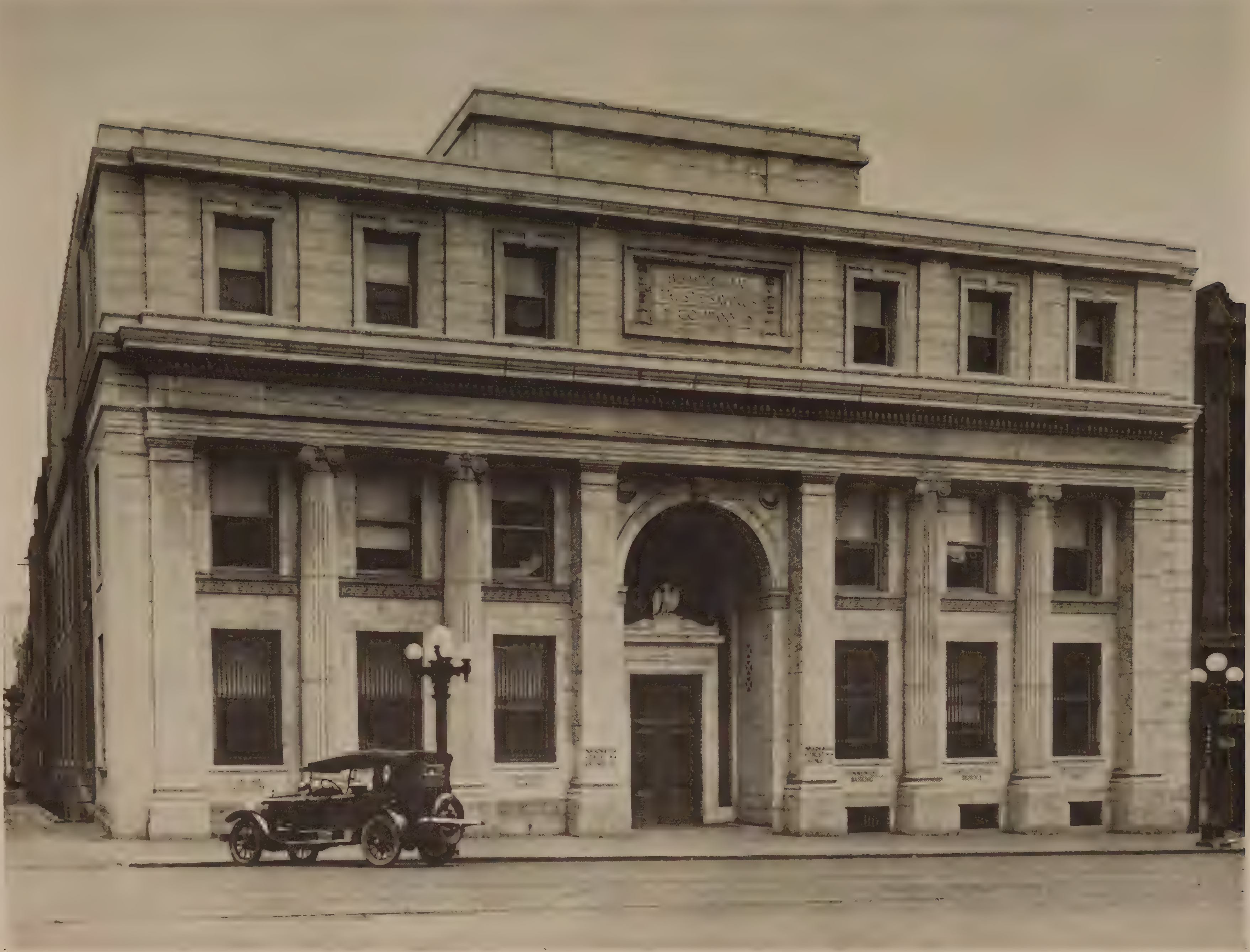


— GROUND FLOOR PLAN —

PLANS, DORMITORY.

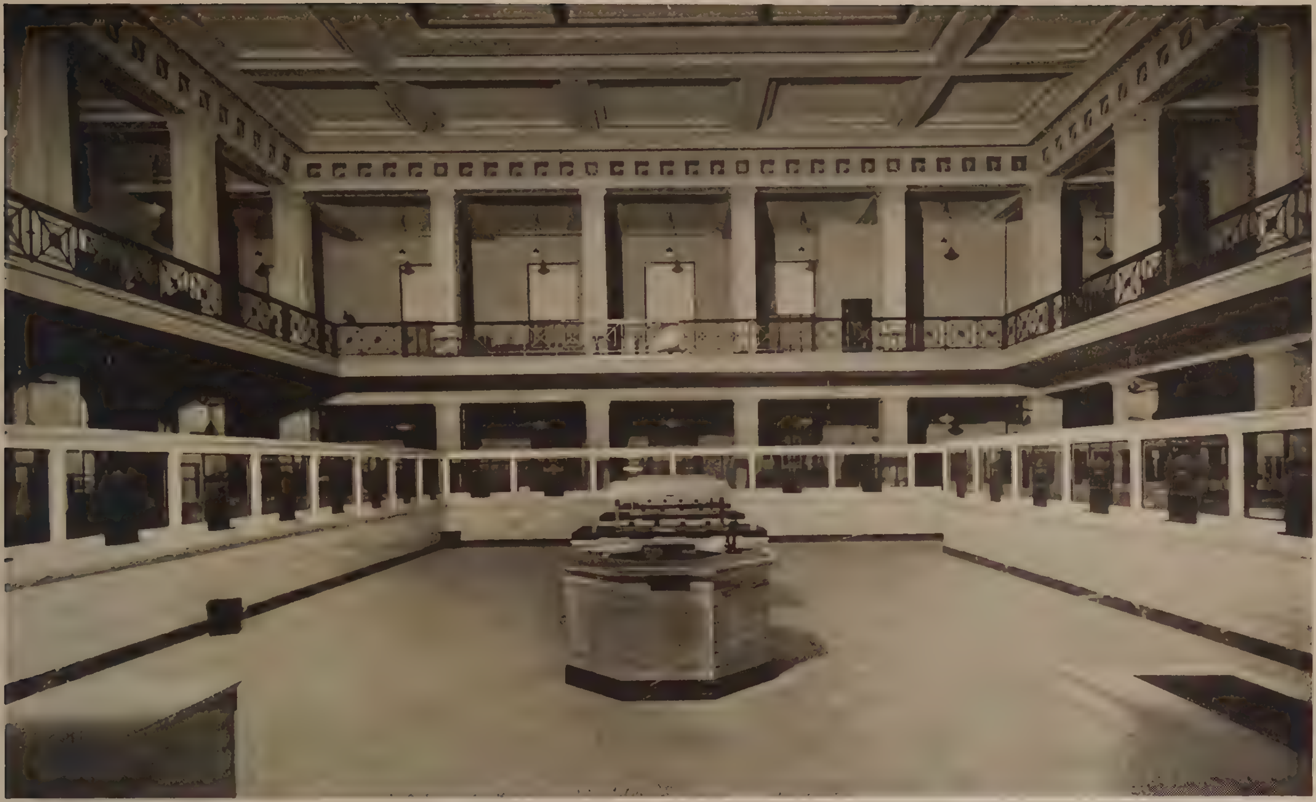
The Warren S. Holmes Co., Architects.

NATIONAL KINDERGARTEN AND ELEMENTARY COLLEGE, EVANSTON, ILLS.

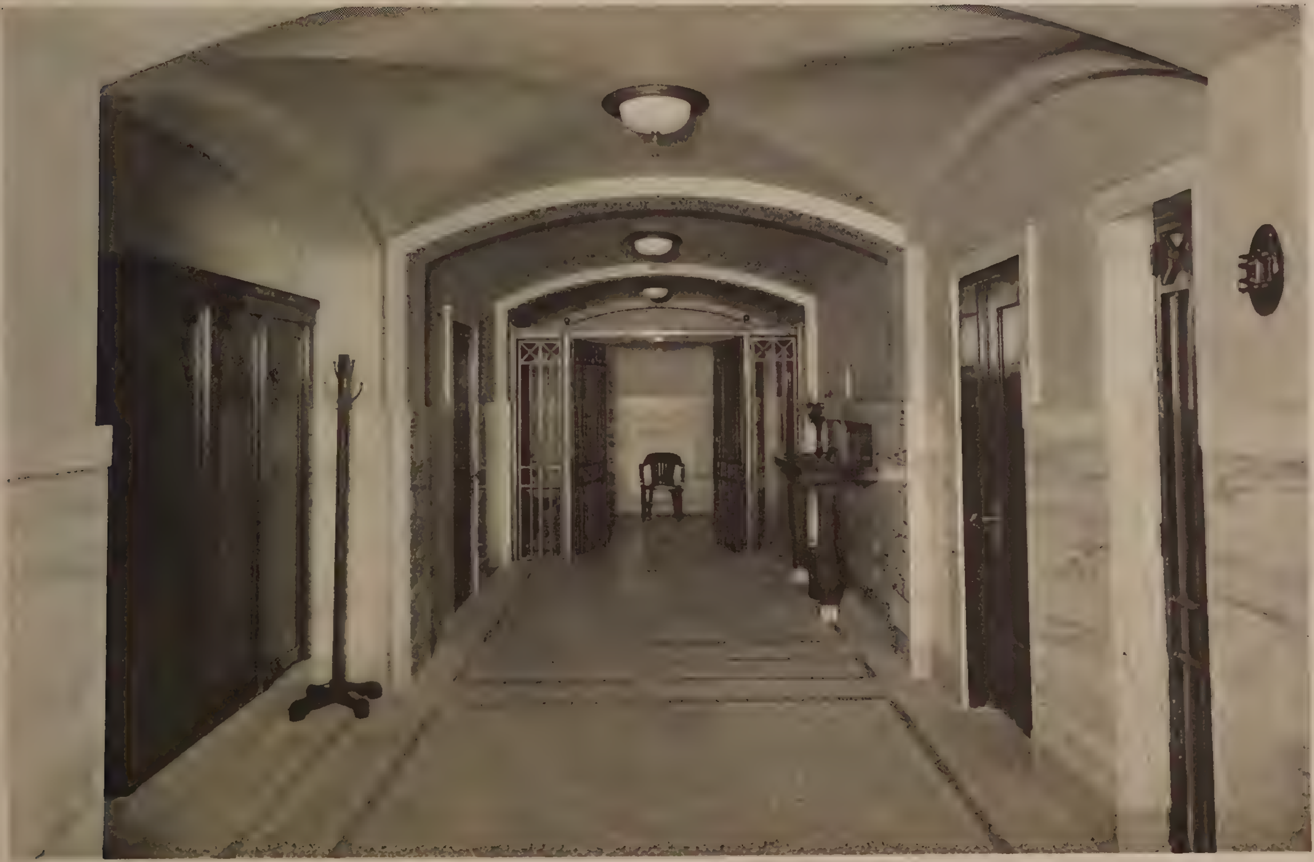


BIRMINGHAM TRUST AND SAVINGS CO., BIRMINGHAM, ALA.

Miller & Martin, Architects.



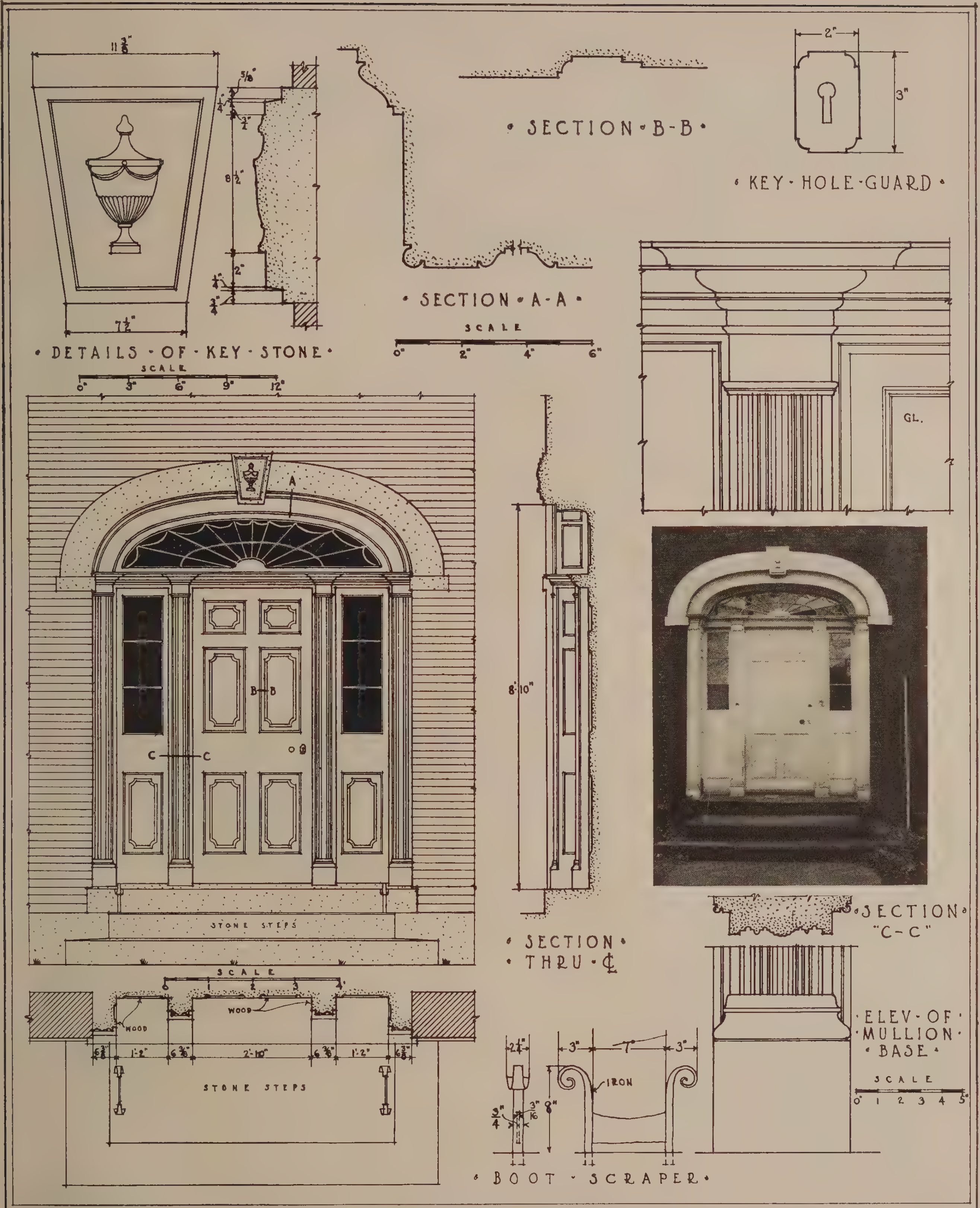
MAIN BANKING-ROOM.



ENTRANCE TO SAFE-DEPOSIT VAULT.

Miller & Martin, Architects.

BIRMINGHAM TRUST AND SAVINGS CO., BIRMINGHAM, ALA.



DETAILS OF KEY STONE

SECTION B-B

KEY-HOLE GUARD

SECTION A-A

SECTION THRU ℄

SECTION "C-C"

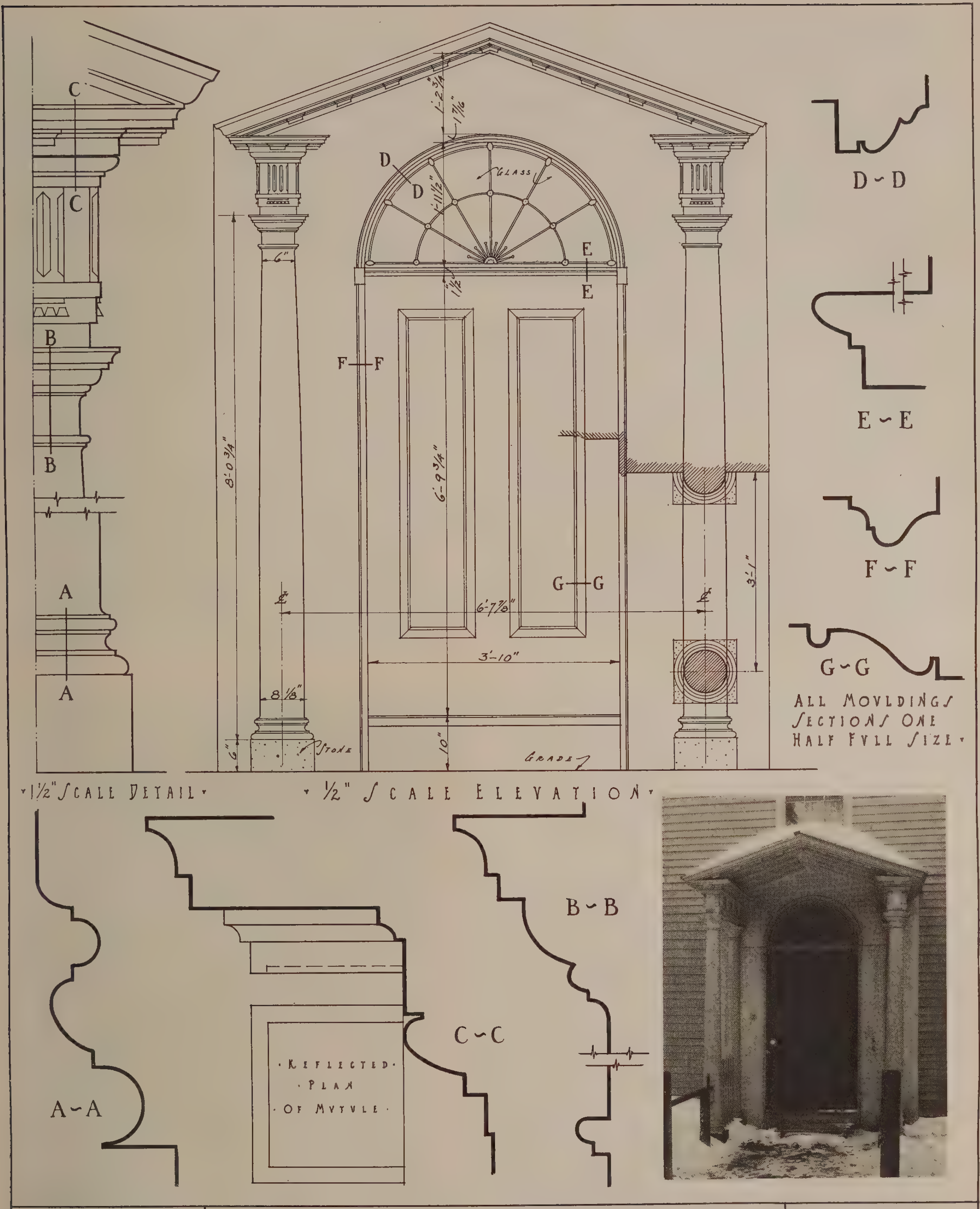
ELEV OF MULLION BASE

BOOT SCRAPER

EARLY COLONIAL
ARCHITECTURE OF
THE OHIO VALLEY

DOORWAY
TO AN OLD RESIDENCE
GRANVILLE OHIO

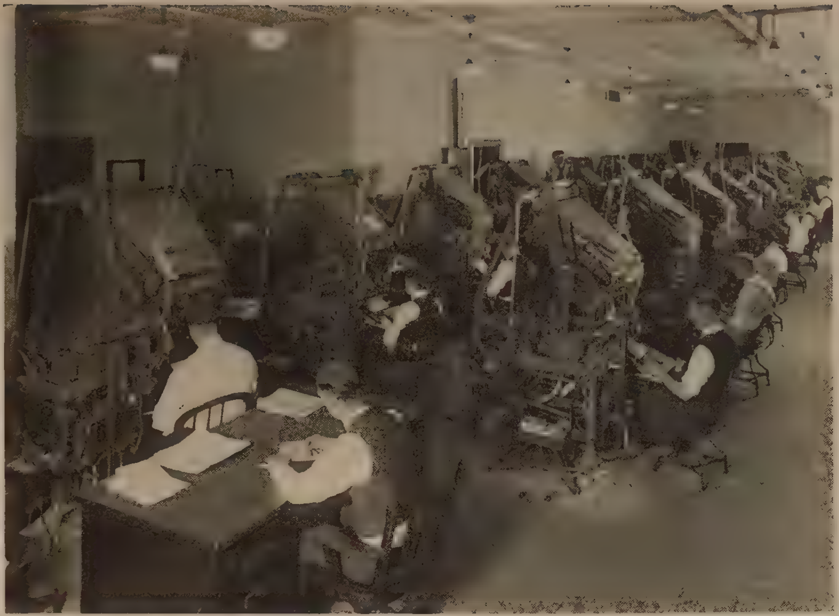
MEASURED AND
DRAWN BY
Daniel W. Weiny



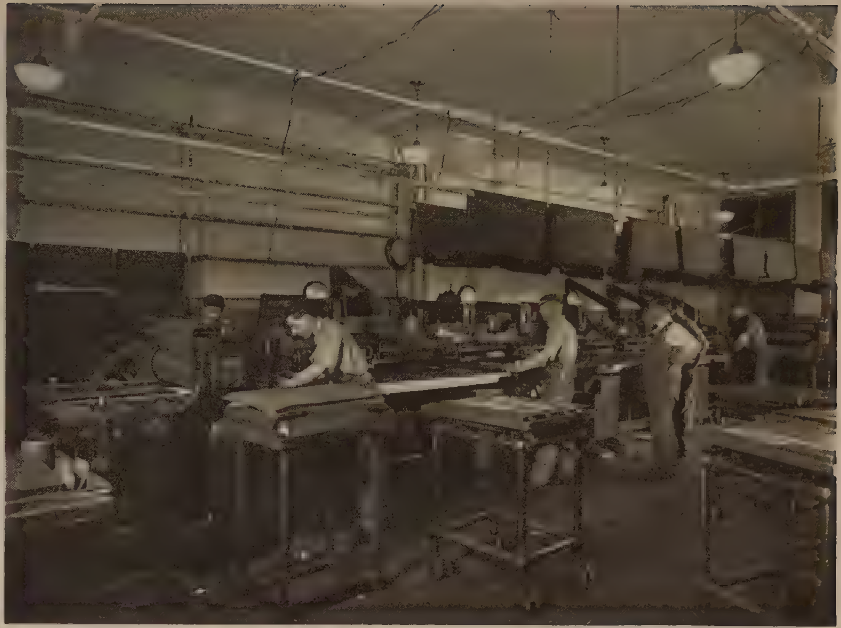
EARLY ARCHITECTVRE OF CONNECTICVT

FRONT ENTRANCE OF AN OLD HOVSE
AT 230 WOOSTER ST.
NEW HAVEN — CONN

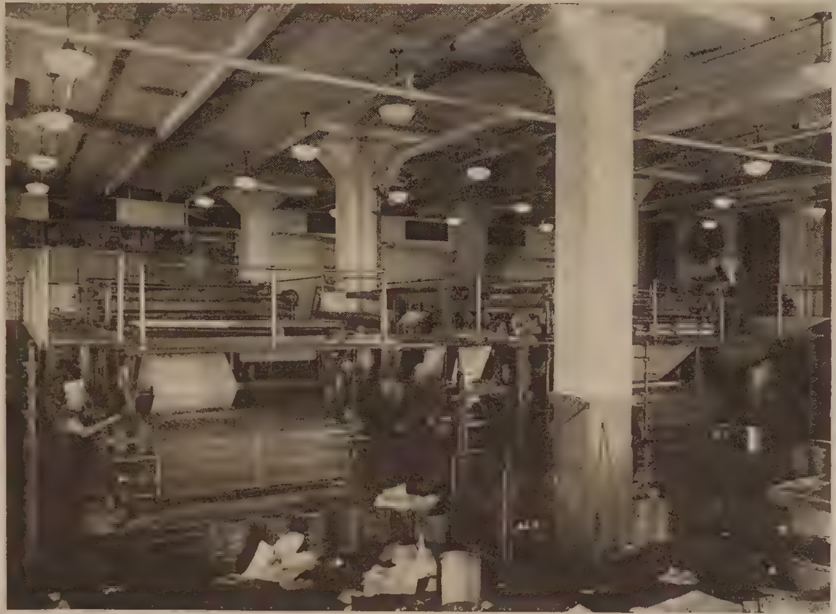
MEASVRED BY J. FREDERICK KELLY
DRAWN BY HENRY S. KELLY



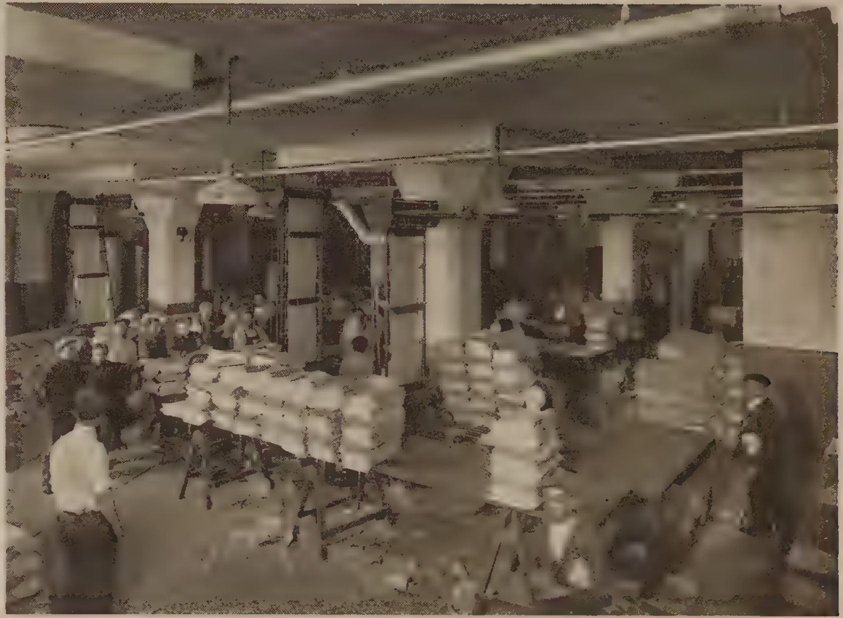
THE BATTERY OF LINOTYPES (FIFTY IN ALL).



MOULDING-ROOM.



THE PRESS-ROOM.



DESPATCH CONVEYOR THAT DELIVERS THE PRINTED PAPER TO THE MAILING-ROOM. Lockwood, Greene & Co., Engineers and Architects.

NEW BUILDING FOR THE NEW YORK "TRIBUNE," 225 WEST 40TH STREET

(*Continued from page* 182)

slight resiliency desirable for the occupancy of this room. The cooling water for the linotypes is returned to the house tank and reused. This is also the case with the stereotype machines (which cast the type-shells for presses), which amount of water largely exceeds that for linotypes.

The composing-room, a busy place anyway, requires concentration on the part of the operators for efficiency and speed. To assist in this as much as possible a quiet room is desired, and a very effective sound-proofing has been applied to the ceiling.

Battleship linoleum, with sanitary linoleum base, is used in the editorial rooms (fifth), business offices (sixth), and feature rooms (seventh).

### Electrical Installation

Electric service throughout the building is direct current, $\frac{1115}{230}$ volt, supplied by the New York Edison Company. To provide maximum reliability of service, three independent feeders are provided, two of which originate at the Edison Co.'s 41st Street substation, and the third being tied into the network feeding this district. These feeders terminate in a street manhole in front of the building, from which point three 1,000,000 circular mill cables feed the main switchboard in the basement machinery-room, where the power is metred and distributed to the various circuits.

Wherever possible, wiring is concealed in conduit run in floor-slabs and walls. The main feeders from the switchboard are carried through the basement floor-slab to a pipe-shaft at the west end of the building, and thence to distributing points on the various floors. A separate switchboard for the control of press motors is located on the press-room mezzanine floor.

Cables of the New York Telephone Co., Western Union Telegraph Co., Postal Telegraph Co., and Stock Quotation Telegraph Co. enter the building through a cable-room, and are thence carried to the pipe-shaft and to the fifth-floor telephone and telegraph room.

In the lighting of the building, particular attention was given to the selection of proper illuminating intensities and uniform distribution demanded by newspaper-publishing work.

### Boiler Plant and Heating System

The building is heated by a low-pressure vacuum system.

The installation consists of 10,000 square feet of direct radiation, 8,600 square feet of equivalent direct radiation in Vento stacks, and 1,000 square feet of equivalent direct radiation for domestic hot-water heating. Two motor-driven vacuum-pumps have been installed, one of which will carry the total load at all times. Provisions have also been made for operating the system as a gravity system in case motor-driven pumps fail.

Temperature control has been installed on all floors from the second to the seventh, inclusive.

A storage hot-water-tank heater has been installed for heating water for shower-baths, basins, etc. The steam for heating this water is taken from the heating boilers in the winter months and from the horse-power gas-boilers in the summer months.

### Fire Protection

The building is sprinklered throughout.

### Economics of the Structural Design

To meet the second of the three requirements mentioned for this structure—namely, a substantial building at the lowest practical cost—the possible types of structural design, particularly steel frame and reinforced concrete, were very carefully considered. Factors bearing on this study were relative cost, the amount of space required, type of interior finish, and city and state building regulations involved. Industrial studies of *The Tribune* requirements indicated seven stories and basement as necessary. While our client wanted interior finish of a suitable type, the expense of complete plaster finish of high-grade office or hotel type was not felt necessary. Square interior columns and flat-slab ceilings, properly painted, gave the necessary result. The building laws involved are such that a building over 100 feet in height from curb to roof requires an additional set of stairs (of the smoke-tower type) and non-combustible floors and trim throughout.

Steel-frame design would have been more expensive than concrete in this case. The thickness of such floor construction would have made suitable story heights for seven floors, within the 100-foot limit, impossible or necessitated extra stair facilities and non-combustible floors and trim if of suitable height.

As wood trim and certain wooden floors in the press-room and composing-room were particularly desired, saving gained by keeping within the 100-foot-story height important, and the interior finish of concrete structure, reinforced-concrete flat-slab type was selected. This type lent itself particularly to the special second-floor design for absorbing press vibration.

### Architectural Features

The architectural design of the building is an economical expression of the dignified, individual, mercantile character of the business that is housed within.

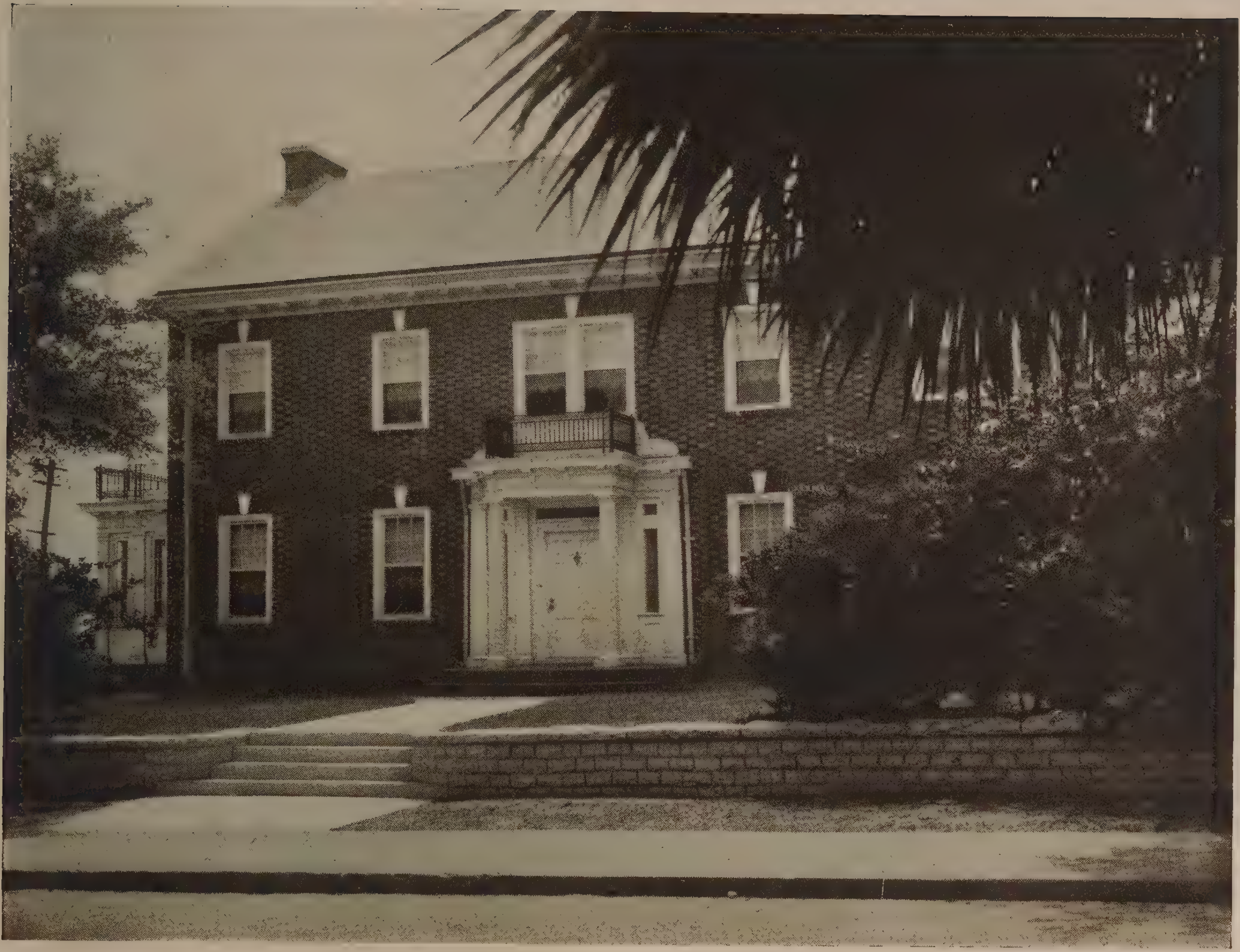
The main façade on the street, which is one hundred feet wide by seven stories high, shows an interesting treatment of simple buff-colored cast-stone work, with the ornamental features in the Spanish Renaissance style. Strong piers with deep-cut moulded arches make the first two stories a good base for the building at the sidewalk. Above, the long vertical stone columns and splayed mullions between the windows which divide the length of the elevation with many lines add desirable height to the general effect of quite a low horizontal building.

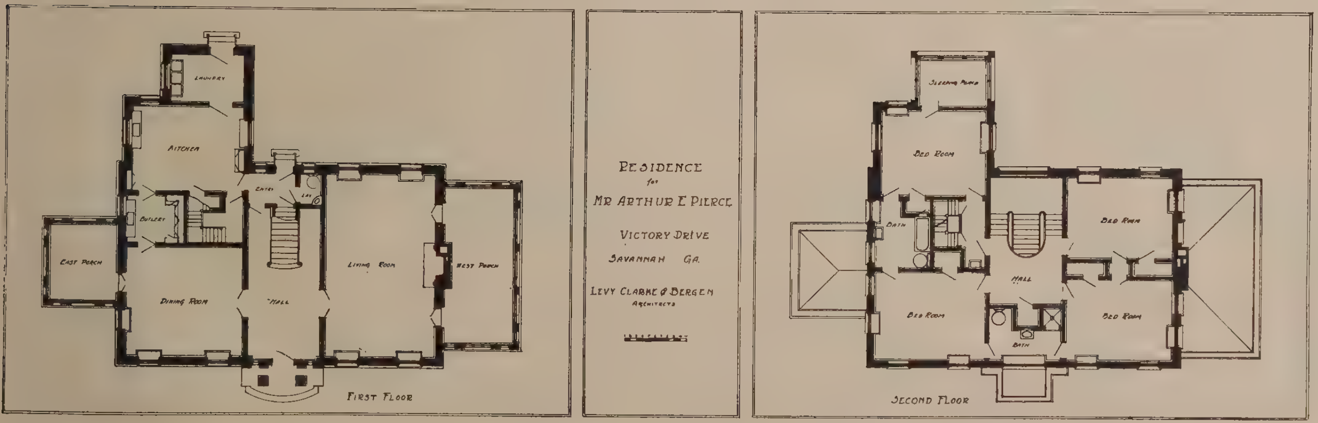
The ornamental details in relief at the end bays above the entrance doors, with the little colonettes, and pilasters, the panels and carved bosses, the arches and spandrels at the first story, and the design of the top parapet with the name sign flanked by arched panels, all are worth noting.

At either side of the two end bays of the first story have been placed large black wrought-iron lamps, bracketed out from the wall, and the scale, detail, and workmanship of these lamps are very successful.

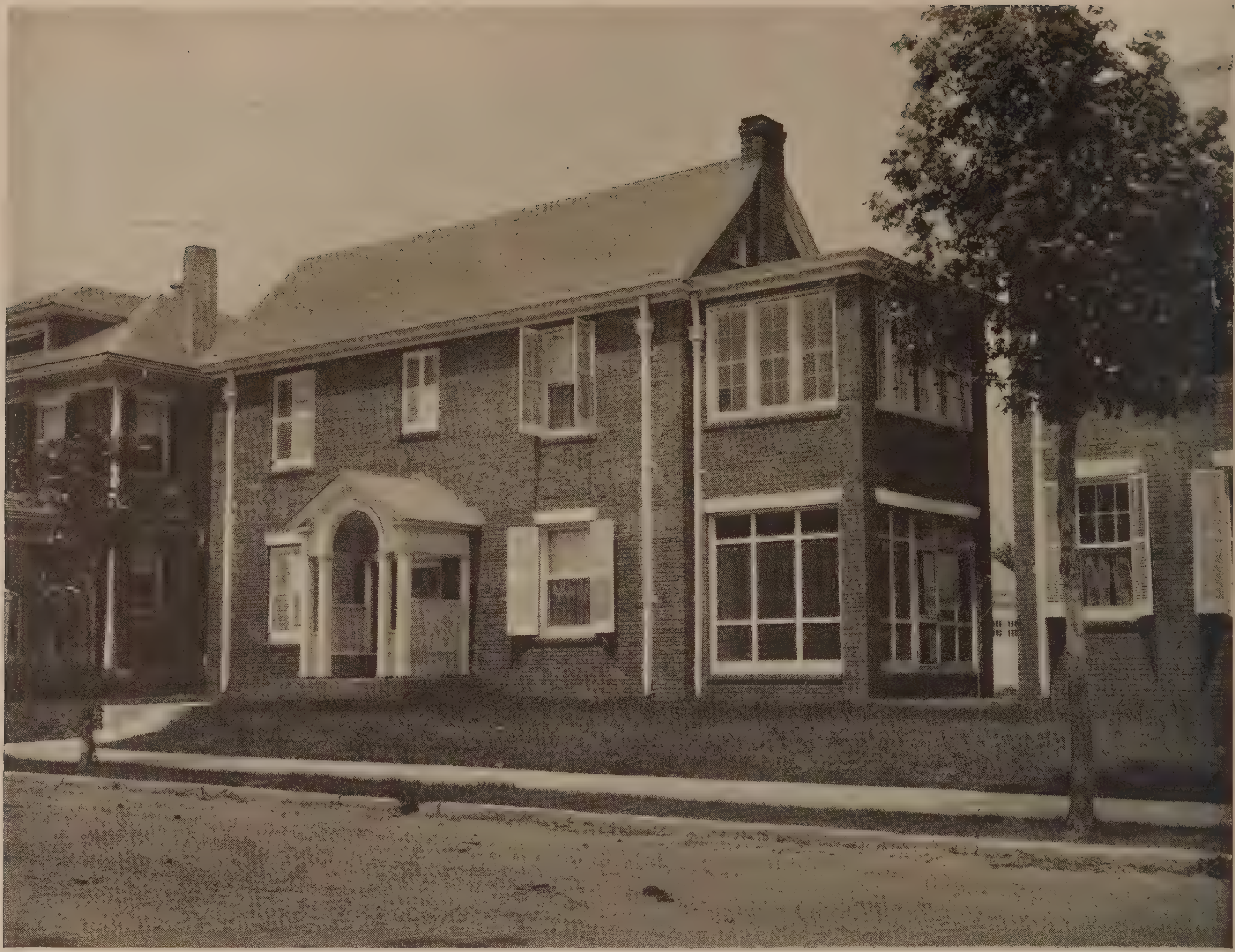
The entrance vestibule is screened by outside and inside doors and grilles of bronze and plate glass, and opens into the main floor lobby and elevator hall. The walls of the lobby are finished with pink-gray marble wainscot and pilasters, the floor is covered with soft, quiet linotile material, and the ceilings are vaulted with plaster-relief band ornaments and mouldings at the cornice.

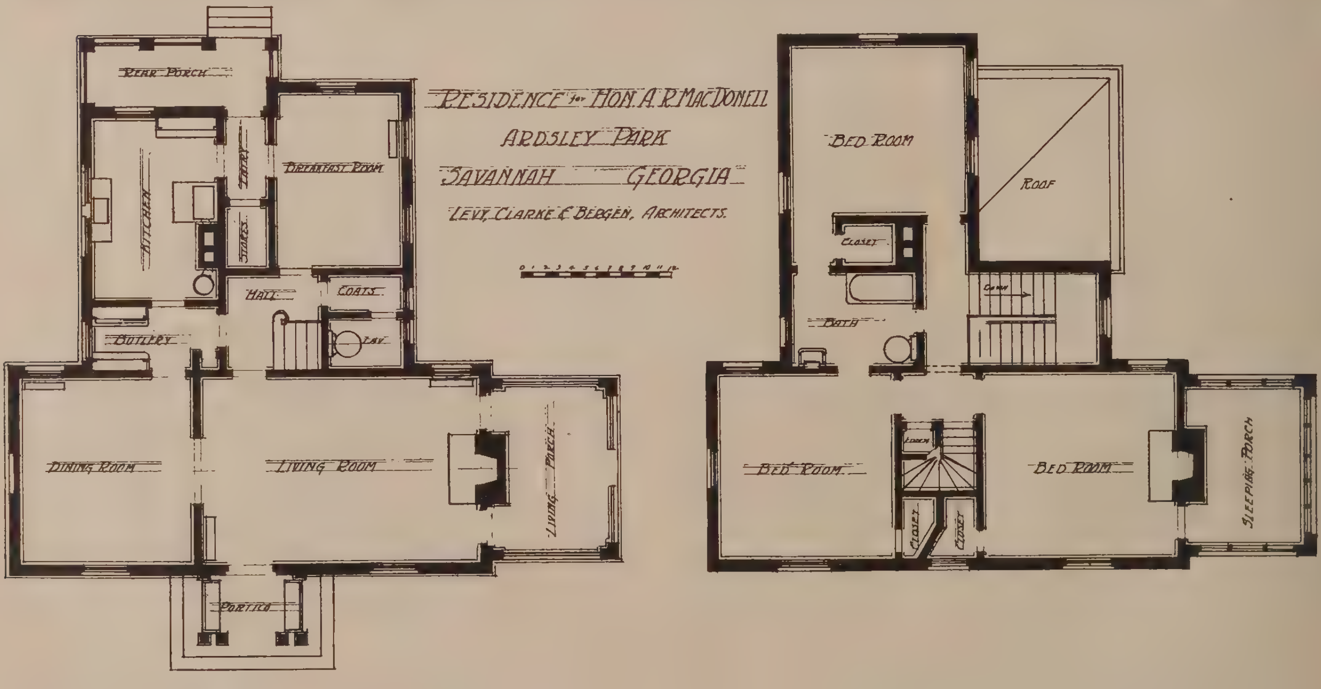
In the upper stories mention can be made of the simple architectural finish of the following parts of the building: The floors of the elevator and stair halls are made of terrazzo. In the toilet and wash rooms the floors are terrazzo with a coved base, and the compartment partitions are sanitary enamelled steel. All of the stair, hall, and elevator doors are kalamein fireproof. The interior of the private office for the editor-in-chief is finished with a stone fireplace and oak mantel, with book closets at either side. All of the wood trim for the interior office railings, partition doors, and casings is of oak. The walls of the office floors generally are painted with a light straw-color paint.



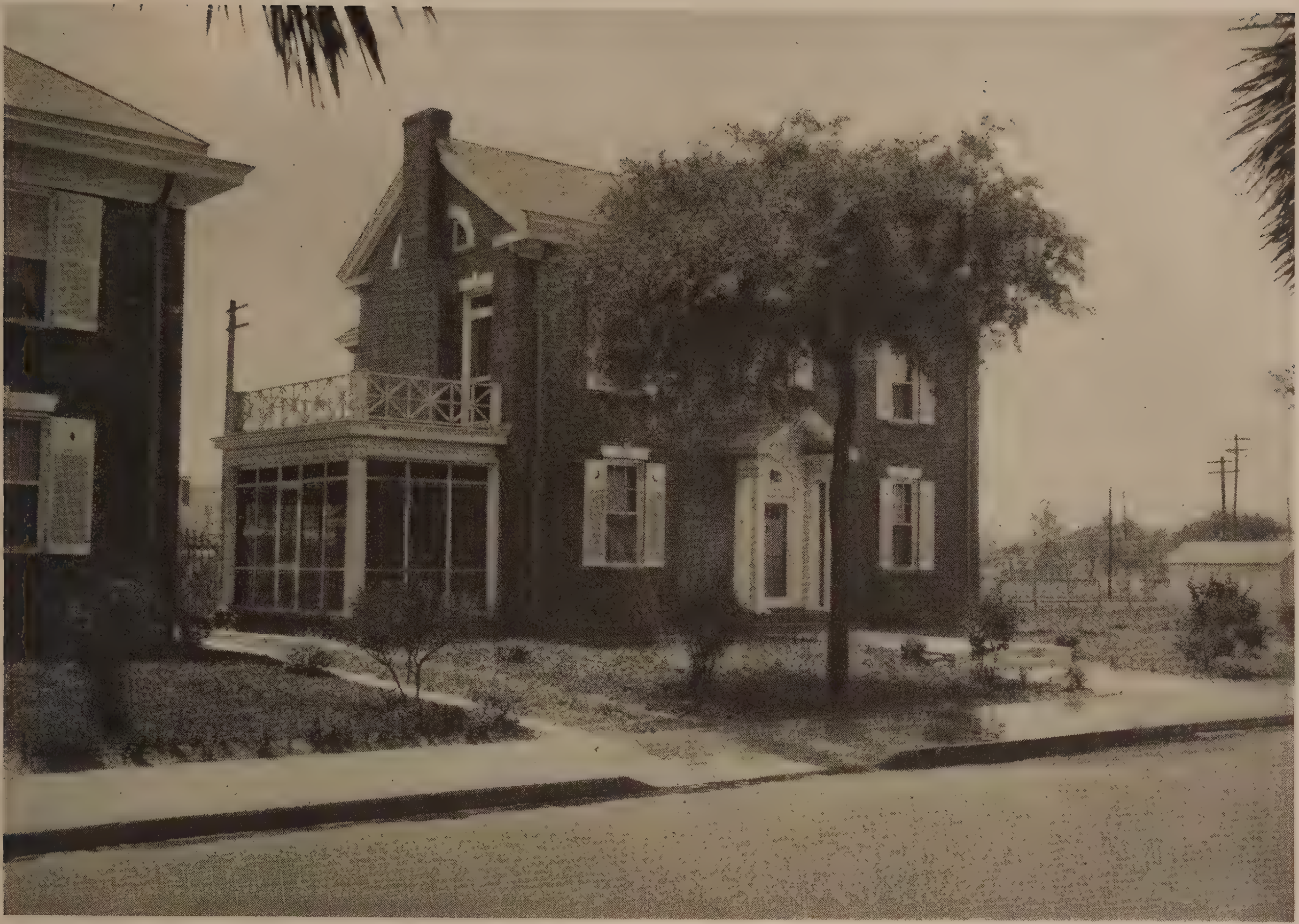


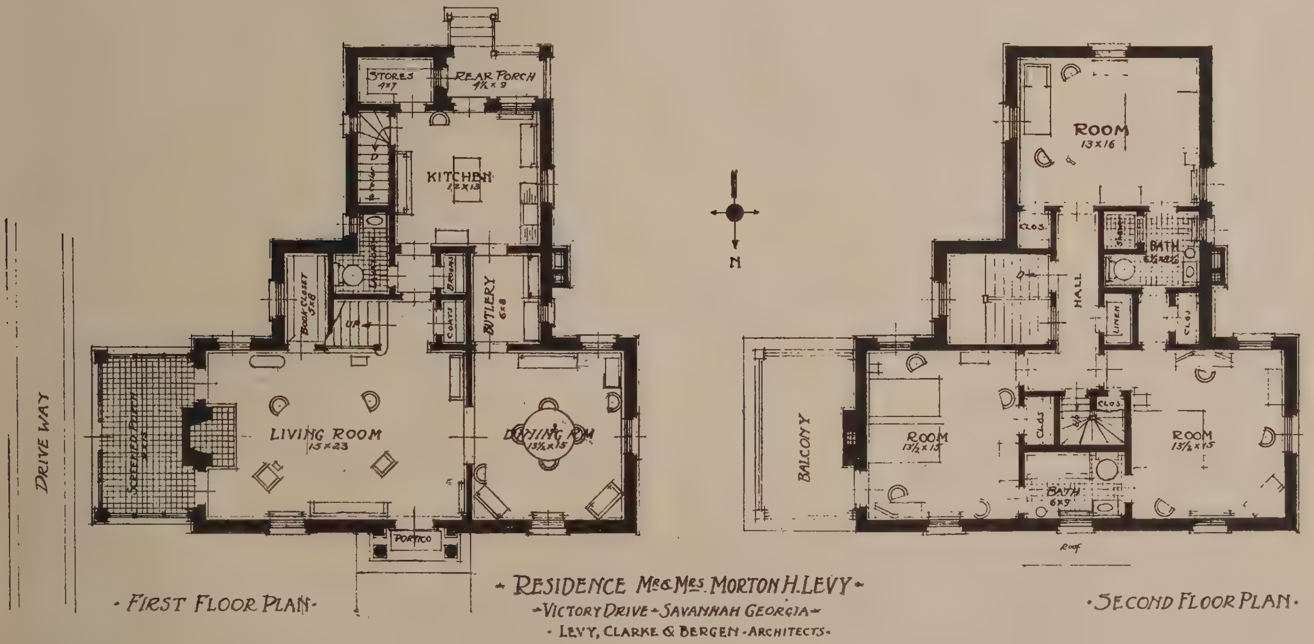
HOUSE, ARTHUR E. PIERCE, SAVANNAH, GA. Levy, Clarke & Bergen, Architects.





HOUSE, A. R. MacDONELL, SAVANNAH, GA. Levy, Clarke & Bergen, Architects.





HOUSE, MR. AND MRS. MORTON H. LEVY, SAVANNAH, GA.

Levy, Clarke & Bergen, Architects.

# Drafting-Room Mathematics

*By DeWitt Clinton Pond, M.A.*

EIGHTH ARTICLE

IT is not often that architectural designers have occasion to be interested in the mathematical problems which it is necessary to solve in order to make the development of their design possible. Recently, however, the author of this article was interested to find that a certain designer had made use of a groined vault as the ceiling over an entrance vestibule, and that he was delving into mathematics for the purpose of finding the radius of each arch. Because this designer is only one of the many who read Architecture this problem has been chosen as one to be dealt with in this article.

The room over which is the groined vault is a rectangular one. For this reason there are two radii to be found, for the two arches which are perpendicular to each other must spring from the same height—an ornamental cornice at the wall—and have the same rise, but the chord of one is longer than that of the other. One section of the vestibule is shown in Fig. 35, and the other is shown in Fig. 36 and an outline plan is displayed in Fig. 37. The dimensions given in the plan show the lengths of the two chords, 18 feet 9 inches and 17 feet 11 inches respectively. In Fig. 38 is shown a diagrammatic representation of the various dimensions which are involved in the problem. It will be seen that the rise of 3 feet 1⅞ inches is common to both arcs, but that the length of one-half of one chord is 9 feet 4½ inches in one case and 8 feet 11½ inches in the other case. The problem is to determine the two radii.

It is possible to turn to several of the handbooks giving architectural data, and find a formula which can be used to solve this problem, but as the method of developing this formula is simple it might be of interest to investigate how the formula is arrived at.

In Fig. 38 there are shown two triangles—*ABC* and *BXC*. The side *AC* of the first triangle is equal to the length *AX* minus *CX*. But *AX* is equal to the radius *AB*, so *AC* equals *AB* minus *CX*. It is understood that if *AB* is squared this value will equal the sum of the squares of *AC* and *CB* and the following equation can be written.

$$\overline{AC}^2 + \overline{CB}^2 = \overline{AB}^2$$

But it has already been determined that *AC* equals *AB* minus *XC* so it is possible to substitute in the formula.

$$(AB - XC)^2 + \overline{CB}^2 = \overline{AB}^2$$

The square of $AB - XC$ is $\overline{AB}^2 - 2 \times AB \times XC + \overline{XC}^2$, and if this is substituted in the above equation the result is

$$\overline{AB}^2 - 2 \times AB \times XC + \overline{XC}^2 + \overline{CB}^2 = \overline{AB}^2$$

It is possible to subtract the square of *AB* from each side of the equation with the result

$$-2 \times AB \times XC + \overline{XC}^2 + \overline{CB}^2 = 0$$

By transposing the first factor to the other side of the equation the following very simple formula is developed.

$$\overline{XC}^2 + \overline{CB}^2 = 2 \times AB \times XC$$

*AB* is the unknown factor in the equation given above, and for that reason it is required that there should be still more transposing and the formula becomes

$$\frac{\overline{XC}^2 + \overline{CB}^2}{2\,XC} = AB$$

If reference is made to the various handbooks containing data on architectural problems it will be found that a formula similar to this is given for the purpose of determining the radius of a circle when a chord and the rise are given. It is usually expressed in the following manner. When the chord and the rise are given, the radius is determined by adding the square of one-half the chord to the square of the rise and dividing this sum by twice the rise.

In the problem under consideration the application of this formula is very simple. One-half of the chord in one case is 9 feet 4½ inches and 8 feet 11½ inches in the other. In order to substitute the proper values in the formula it will be necessary to refer to a book giving the squares of the various dimensions. In this series of articles the author has recommended the use of the Smoley's book of tables, as this book furnishes in a convenient manner the squares and logarithms of dimensions, logarithms of numbers, and functions of angles, and other necessary information. In the present case the first step to be taken is the notation at the top of the sheet of calculations the data of which are already established.

(9 feet 4½ inches)$^2$ = 87.8906
(8 feet 11½ inches)$^2$ = 80.2517
(3 feet 1⅞ inches)$^2$ = 9.9619

It will also be necessary to refer to the table of decimal equivalents of a foot to find that 3 feet 1⅞ inches is equivalent to 3.1563 feet.

By substituting the values given above in the formula the following results are obtained.

$$\frac{87.8906 + 9.9619}{2 \times 3.1563} = AB$$

$$\frac{80.2517 + 9.9619}{2 \times 3.1562} = AB^1$$

In previous articles the use of logarithms has been strongly recommended and, although the necessity of adding the two values in each of the two equations makes the use of logarithms less simple than in previous problems, still to one who is accustomed to their use they can be employed even in the present case. Of course to one who uses the slide rule the solution of the above problem is simple enough

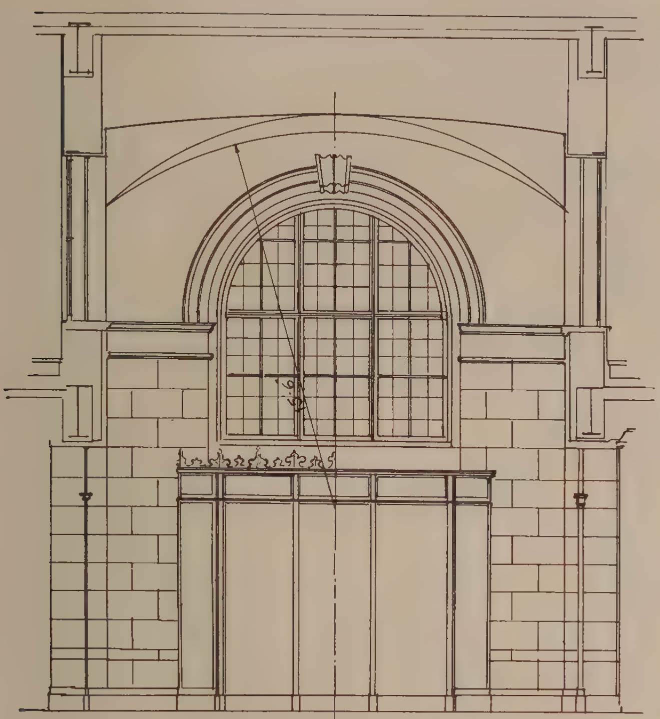


FIGURE 35

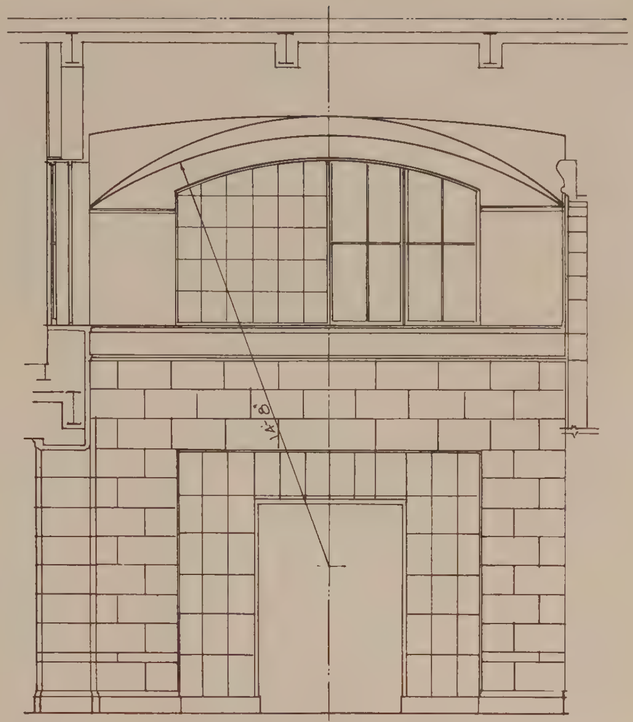


FIGURE 36

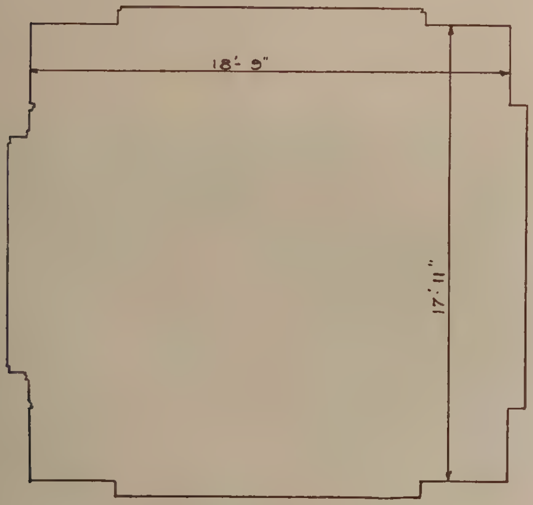


FIGURE 37

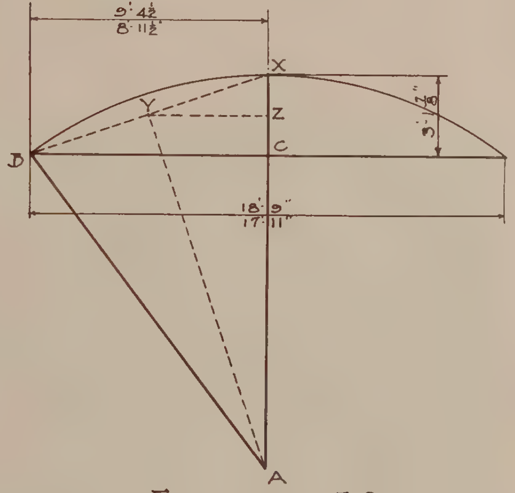


FIGURE 38

when the necessary addition has been made. In any case the expression must be made one in which all the calculations can be expressed as products of multiplication or division. This is done below.

$$\frac{97.8525}{2 \times 3.1562} = AB$$

$$\frac{90.2136}{2 \times 3.1562} = AB^1$$

The next step is the determination of the logarithms of the various factors in the equations. For those who have not followed the discussions in the previous articles it might be well to indicate the method employed in determining the logarithms of the various numbers in an expression similar to the one given above. In a book of tables, such as the one reccommended above, it is possible to find listed the logarithms of various numbers carried out to five places. If the reader does not have such a book at hand he can refer to any handbook published by one of the various steel companies. In the present case it might be advantageous to investigate the use of such a table. It will be found that logarithms are given for numbers from 0 to 1,000. In the left-hand column the numbers are listed from 0 to 99, and at the top they are given from 0 to 9. In order to determine the logarithm of a number such as, for example, 538 it will be necessary to look down the numbers at the left until 53 is reached, and then across at the top until 8 is found. Then by reading over to the left from 53 and down from 8 the number 73078 is found. This number must be placed at the right of a decimal point and at the left of it must be placed a "characteristic." This characteristic is a number. For numbers between 0 and 10 the characteristic is 0, and for numbers between 10 and 100 the characteristic is 1. In the same manner the characteristic for numbers between 100 and 1,000 is 2 and 3 for numbers between 1,000 and 10,000. For decimals the characteristics are always minus quantities and the numbers represent one more than the number of zeros at the right of the decimal. For the number under consideration—538—the characteristic would be 2 as the number is between 100 and 1,000. The logarithm of 532 is therefore 2.73078.

If the number had been 53829 then the characteristic would have been 4, and the number at the right of the decimal would have been determined by proportion between the number 73078 and 73159 which is the number given in the table corresponding to 539. The difference between 73078 and 73159 is 81. 53829 is 29 units greater than 53800, so if 81 is multiplied by 0.29 the result can be added to 73078 and the proper number corresponding to 53829 will be determined. 81 × .29 = 23.49. By adding 23 to 73078 the result of 73101 is obtained as the proper corresponding number, and if this is placed at the right of the decimal and the characteristic 4 is placed at the left, then the proper logarithm—4.73101—is obtained.

This explanation of the method of obtaining logarithms of numbers is of necessity cursory, but it may serve to show to those who have not followed the previous articles how the logarithms which will be used in the following calculations are obtained. It may also serve as a brief review for the readers who have followed the articles.

It is customary to obtain all the logarithms of all the known quantities at the beginning of the calculations, and this practice will be followed. There are four logarithms to look up and these are given below.

log 97.8525 = 1.99057
log 90.2136 = 1.95527
log 2.0 = 0.30103
log 3.1562 = 0.49917

In order to carry out the calculations for the purpose of finding the value of *AB* in the equations given above, it will be necessary to add the logarithms of 2 and 3.1562, and subtract their sum from the logarithm of 97.9325.

log 3.1562 = 0.49917
+ log 2.0 = 0.30103
0.80020

log 97.8525 = 1.99057
− 0.80020
1.19037 = log 15.50 feet

The radius of the arch which spans the long dimension of the vestibule is 15 feet 6 inches. The calculations for obtaining the radius for the arch having the shorter chord are very simple.

log 90.2136 = 1.95527
− 0.80020
1.15507 = log 14.29

The radius will be taken as 14 feet $3\frac{1}{2}$ inches. These two dimensions are used on the section as shown in Fig. 35 and Fig. 36. These are fairly full explanations of a problem which is not particularly difficult, but the principles which have been developed can be applied in so many cases that it is of value to have a thorough understanding of them.

The formula which was used in the problem was developed as a problem in geometry, but the same problem can be solved in a very simple manner by means of trigonometry. In the diagram shown in Fig. 38 the triangle *BAX* is divided into two triangles by the line *AY* which is perpendicular to *BX*. It can be seen from an inspection of the figure that *BAX* is an isosceles triangle, having *AB* and *AX* equal. A line drawn through *A* and perpendicular to *BX* must bisect the angle *BAX*. The triangles *ZAY* and *BCX* are similar as the sides of one are respectively perpendicular to the sides of the other. The angle *CAY* is equal to *CBX*, and so, in order to find the value of one-half of the angle *BAC*, it is necessary to divide the rise of the arc by one-half the chord, which will give the tangent of the angle *CBX*. Once this angle is obtained, it is necessary to multiply it by 2 in order to determine the value of *CAB*. Having obtained *CAB* it will be possible to determine the length *AB* by dividing the sine of the angle by the length *CB*. The calculations are given below in order to show how this is done, and also to check the results found above.

As it is not necessary to determine the squares of any of the dimensions, all the logarithms can be found in the tables for lengths given in feet and inches. This is a much more simple process than having to determine the logarithms for lengths given in feet and decimals of a foot. In order to find the tangent of *CBX*, it will be necessary to subtract the logarithm of 9 feet $4\frac{1}{2}$ inches from that of 3 feet $1\frac{7}{8}$ inches.

log 3 feet $1\frac{7}{8}$ inches = 0.49917
− log 9 feet $4\frac{1}{2}$ inches = 0.97197
9.52720 − 10

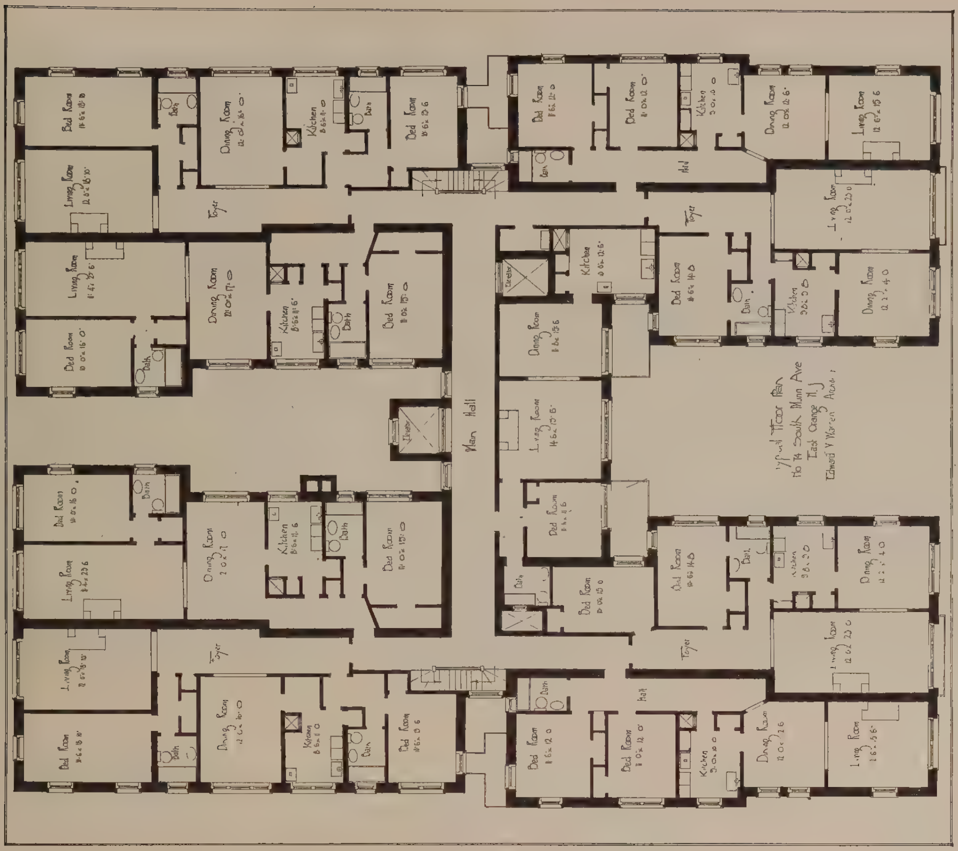
9.52720 = log tan 18 degrees 36 minutes 25 seconds.

The angle *XAB* equals twice this angle or 37 degrees 12 minutes 52 seconds, and in order to obtain the length *AB* in Fig. 38 it will be necessary to divide the sine of this angle by the length of one-half of the chord, or to subtract the logarithms of these values.

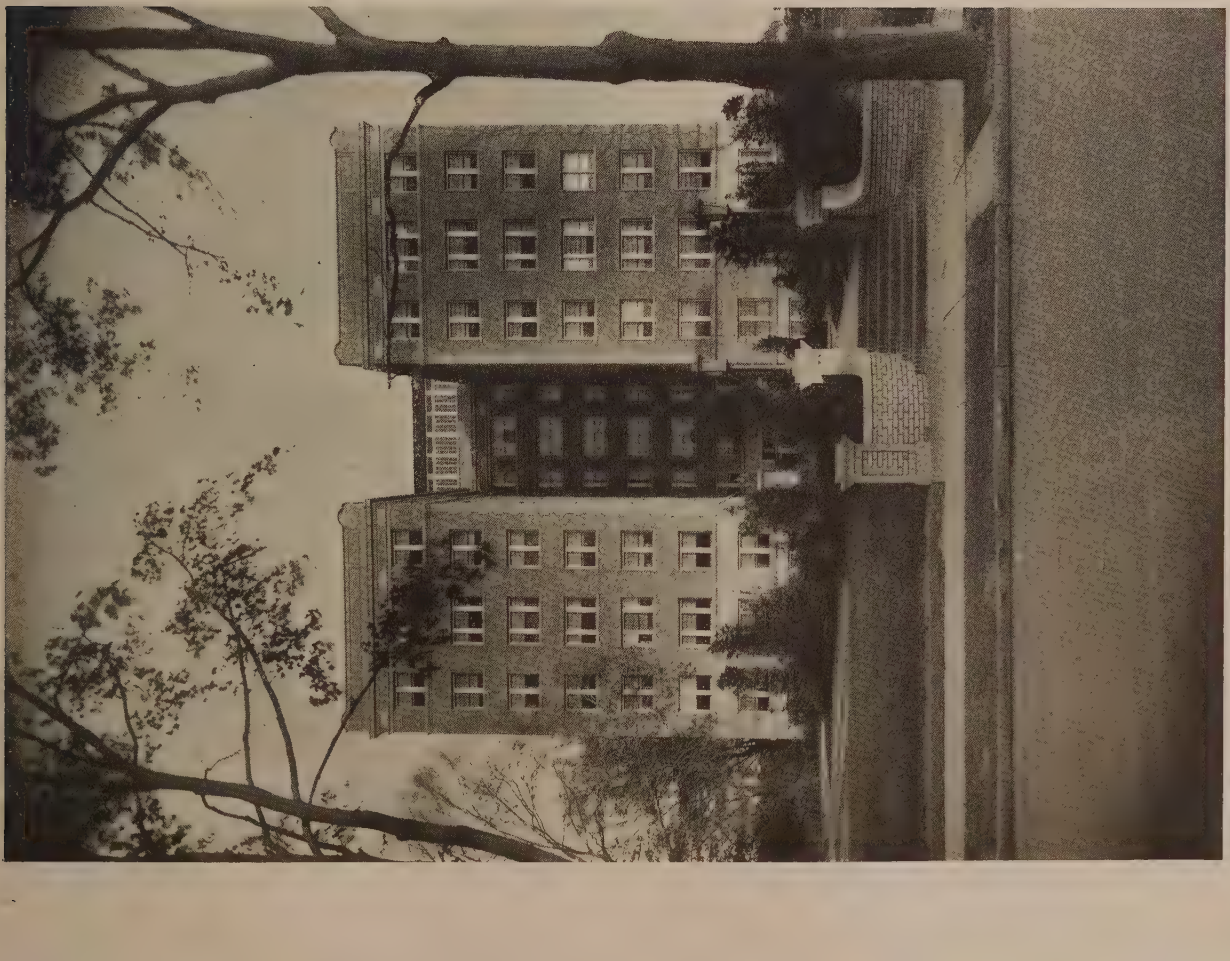
log 9 feet $4\frac{1}{2}$ inches = 0.97197
log sin 37 degrees 12 minutes 50 seconds = 9.78160
1.19037

1.19037 = log 15 feet 6 inches

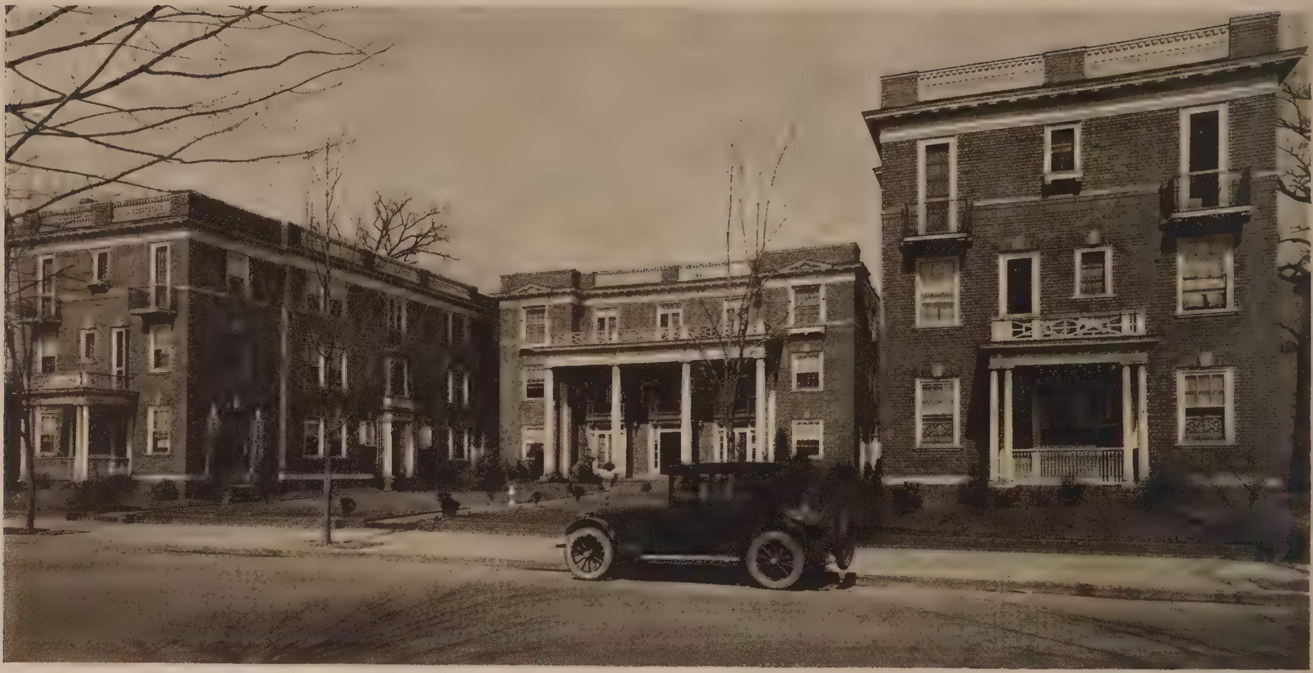
This result checks with the one obtained above. The process of obtaining the radius by means of trigonometry seems more simple to the author than the one in which the formula is used. It will be noted that the results check exactly in spite of the fact that it has been necessary to work to the nearest fraction of an inch and to interpolate in order to find the angle *XAY* and the sine of *XAB*. All results of this nature should check very closely.

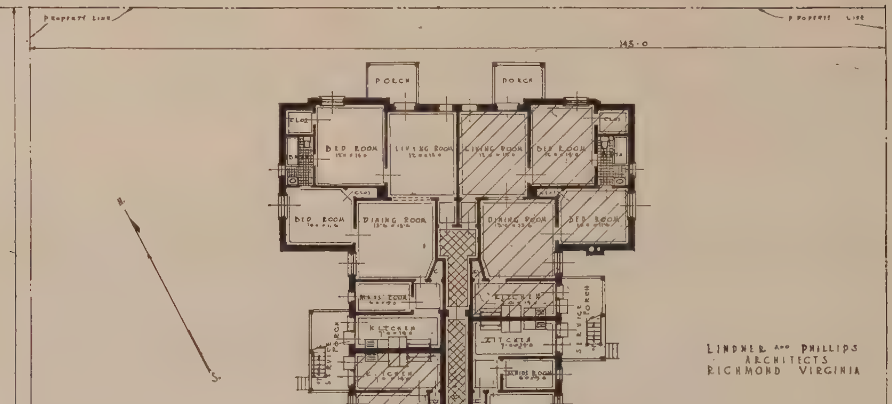


Ed. V. Warren, Architect.



APARTMENT-HOUSE, 74 SOUTH MUNN AVENUE, EAST ORANGE, N. J.





APARTMENT-HOUSE, RICHMOND, VA. Lindner & Phillips, Architects.

# Construction of the Apartment-House

*By H. Vandervoort Walsh*
Instructor of Construction, School of Architecture, Columbia University

## ARTICLE V

### Floors in Ordinary Construction

ATTENTION was called, in a previous article on the principles of ordinary construction, to the fact that floors over the cellar were built of steel I-beams and reinforced concrete slabs in order to act as barriers against any fires that might start in the basement. However, the floors above the first may be and are constructed of wooden floor-joists, although these are required to be 3 inches thick, at least, in order to make them more fire-resisting and slower to burn through. This minimum thickness is required in spite of the fact that the thinner 2-inch-thick joists would be more economical of material.

There is nothing unusual, then, to find builders of apartment-houses selecting those sizes of 3-inch-thick joists which give the greatest economy. Spans are arranged so that the usual 3-inch by 8-inch joist can be used up to its very limit, even though excessive deflection may result. In the great majority of ordinary constructed apartments the 3-inch by 8-inch floor-joist is the standard size used throughout, much as the 2-inch by 10-inch joist is used throughout houses of frame construction. The formula employed for computing the safe load on these floors is generally:

$$\left.\begin{array}{l}\text{Safe load in pounds per}\\ \text{square foot of floor area}\end{array}\right\} = \frac{\begin{array}{l}\text{Allowable working stress in}\\ \text{pounds per square inch}\end{array}}{9} \times \frac{\text{Breadth} \times (\text{Depth})^2}{\left.\begin{array}{l}\text{Distance on cen-}\\ \text{tres in feet}\end{array}\right\} \times (\text{Span in feet})^2}$$

If, using this formula, and taking the average arrangement which one finds in apartments wherein the span for the floor-joists is about 20 feet and 3 inches by 8 inches, Long Leaf Yellow Pine joists (actual size $2\frac{3}{4}$ x $7\frac{1}{2}$) are used, spaced 16 inches on centres, and a working stress of 1,600 pounds per square inch assumed, one finds the following safe load for this construction per square foot.

$$\left.\begin{array}{l}\text{Safe load in pounds}\\ \text{per square foot}\end{array}\right\} = \frac{1{,}600}{9} \times \frac{2.75'' \times (7.5'')^2}{1.33 \times (20)^2} = 51 + \text{ pounds per square foot}$$

However, if we now take a live load of 40 pounds per square foot, as assumed by many building codes, and add to this 17.5 pounds as the minimum for the weight of the floor construction, making a total of 57.5 pounds per square foot which must be supported upon the above floor, the figures show that we are clearly in excess of the allowed load on such a floor.

Does this bother or phase the builder of apartment-houses? Not at all! He merely substitutes in the formula the rough or nominal size of the floor-joists and his calculations for the allowable load come out to 64 pounds per square foot, which is certainly above the loads which were assumed to be developed on the floor. He claims the floor is safe, and so builds it, and it stands and also passes the building department.

But calculations would show that the deflection on such floor-joists would be in excess of the orthodox one-three-hundred-and-sixtieth of the span, which ought, by all the rules of the handbooks, to crack the plaster ceilings. But this does not even bother the builder of apartment-houses, for he figures that the joists will deflect when put into position before the plaster is added, and then, if it is too noticeable, the under sides can be furred off and made level for the lath on which the plaster will be spread. This slight discrepancy between the theoretical way of building and the actual way that the floors are constructed is an indication of the indifference which practical builders have for theory. They are, as a rule, required by the building code to keep within the safe loads, so why, they say to themselves, bother about deflection, which can be taken up by interior partitions or furring?

We might mention here, too, the fact that building codes show a tremendous difference of opinion as to what should be the live load upon the floors of tenements. Milwaukee, Wis., thinks it should be only 30 pounds per square foot. Charlotte, N. C., thinks it should be 100 pounds per square foot. Thirty-seven cities think it should be 40 pounds above the first floor, thirty-three think it should be 50 pounds, twenty-five consider 60 pounds as necessary, and a few others require 70 or 80 pounds to be used in the calculations.

This means that in one city 3-inch by 8-inch joists, space 16 inches on centres, are safe for tenements over spans of 22 feet, whereas in other cities 14 feet is the theoretical limit of this floor construction, and if the same 22-foot span is to be built over, then 3-inch by 12-inch joists would have to be used.

In New York City the building code once limited the allowable working stress on Yellow Pine beams to 1,200 instead of 1,600. Now spruce beams are permitted to have this stress of 1,200 on them, whereas before they were held within the limits of 800 pounds per square inch. This means that throughout the city spruce floors are now doing the same work that formerly only Long Leaf Yellow Pine floors were allowed to do. Likewise the building code of this same city once required that the floors of tenements should be constructed to hold a live load of 60 pounds per square foot, but now it is reduced to 40 pounds. So it is that, within one city, there has been much change of opinion upon the strength of tenement-house floors, and there is no wonder that the average builder does not respect the theoretical strength as the absolute measure from which no variations up or down can be made. The result is that they work just as near to the minimum limits of the building code as they can.

Here is one way of figuring out the floor plans of an apartment as used by one builder:

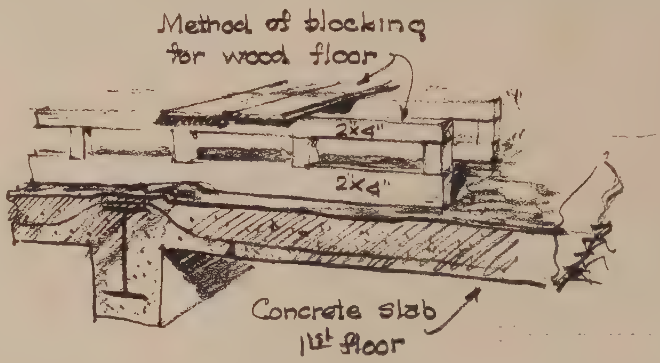
| Assume the following loads: | Weight, pounds per square foot |
|---|---|
| L. L. Y. P., 3-inch + 10-inch joists spaced 16 inches o.c. | 6.5 |
| Upper flooring | 5.0 |
| Plaster ceiling | 7.5 |
| Live load | 40.0 |
| Total | 59.0 |

Using formula, and assuming a span of 26 feet:

$$\left.\begin{array}{l}\text{Safe load in pounds}\\ \text{per square foot}\end{array}\right\} = \frac{1,600}{9} \times \frac{3 \times (10)^2}{1.33 \times (26)^2} =$$

59 pounds per square foot, which checks up with the load above

This is rather close figuring, is it not? The plans were laid out by this builder with spans for the floor-joists of 25 to 26 feet. He could make the figures talk, like a statistician, and prove anything. He winked at the engineers in the back of his brain, for they would tell him that these joists would have a deflection of more than 2 inches at their centre. But that to him was a simple problem. In the first place the full live loads he knew would never develop in the beginning, so that the beams would not deflect anything like the amount indicated by the theoretical formula. Whatever deflection did take place under the normal dead loads would occur before the plaster was added, and so would not affect it. Moreover, the interior wooden stud partitions, dividing off the rooms, although they did not support these beams, yet were erected within the 26-foot span, and since they came over each other on the various floors they acted as stiffening supports in the middle portion of the beams, for the partition caps at each floor were snugly placed under the joists, and the studs of the partitions above were carried down upon the cap of the partition below and not upon the tops of the joists. Thus these interior partitions resisted the sag of the joists when the live loads developed, and yet at the same time did not really support them, for, if they were burned away, the joists would be held by their end bearings.



Now wherever there are clear spans across a room, and no interior partitions, this cannot be done, and the deflection of the floor-joists must be considered with more respect. For 3-inch by 8-inch joists the span ought not to be more than 15 feet, if it is assumed that the full live load will develop; but it is well known that it never does, and so common practice shows the use of this size joists over spans as great as 18 feet. However, there are plenty of examples where this disrespect for the deflection of wooden beams has caused disastrous failures in the plaster ceiling. These failures do not develop in the beginning, but rather after a year or so, when the steam heat has begun to dry out the wood, and pianos have been moved into the apartments, and other pieces of furniture of considerable weight have had time to impress themselves upon the construction, for it is the nature of a wooden beam to keep on increasing its deflection slightly under a load that is continually applied. From the speculative builders' standpoint, this is not as serious a question as the initial cost, but to the one who has invested money in a structure of this kind the cost of maintenance is critical. Certainly the young people cannot be kept from dancing and shaking things up a bit, nor the children from jumping, nor piano-players from being placed in the apartments, and if the floor beams yield to the changing loads too much, there are bound to be disastrous effects upon the plaster.

A very simple method of determining the theoretical deflection of floor-joists of Long Leaf Yellow Pine is as follows:

$$\text{Deflection in inches} = \frac{\text{Load in 1,000-}}{\text{pound units}} \times (\text{Span in feet})^2 \times \left\{\begin{array}{l}.0001437 \text{ where } 3'' \times 8'' \text{ joists are used}\\ .00007069 \text{ where } 3'' \times 10'' \text{ joists are used}\end{array}\right.$$

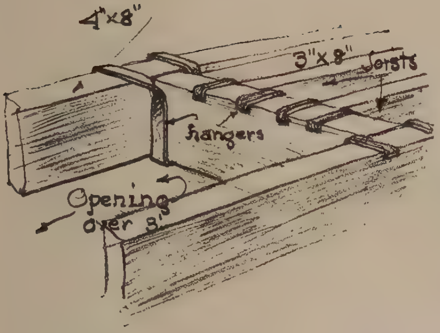
To be conservative, the deflection found by the above should not be in excess of one-three-hundred-and-sixtieth of the span.

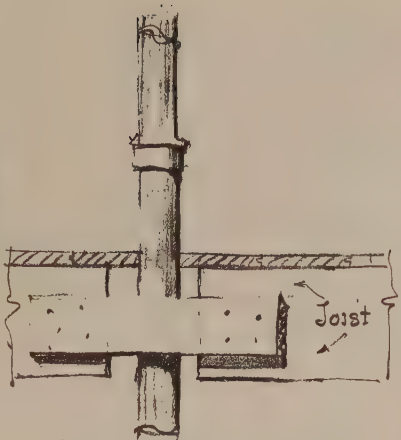
Now there are times when deflections of floor-joists are very serious, and these are when a fire is raging through the building, eating the strength out of them. Eventually, as they break near the centre, their ends will have a tendency to overturn the outside walls, unless a 3-inch bevelled fire-cut has been made on the bearing end of each one.

But ordinarily the floors are stiffeners to the walls, for every 6 feet one of the floor-joists is anchored into the wall with an iron anchor. Each joist has a bearing on the wall of at least 4 inches.

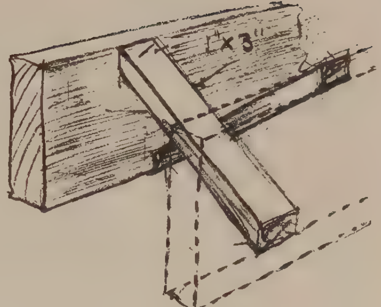
The interior ends are supported in various ways. Interior fire-walls of brick may be used to support them, but generally speaking the usual method is to employ steel columns and steel girders. Small Bethlehem 8-inch and 10-inch H columns are used a great deal, although steel-pipe columns filled with concrete, are often seen. These columns are spaced about 15 feet on centres, so that the steel girders have a span of about this much. Standard or Bethlehem I beam sections are used for the girders, and the wooden floor-joists are usually framed into their bottom flanges; that is, the joists are notched out so that they have their bearing upon the lower flanges of the girders. If the steel girder is too deep for this method of support, a wooden cleat is bolted to the web, and partially rests upon the lower flange. This cleat can be made deep enough to give the correct bearing height for the floor-joists. Another method which is resorted to, when the girders are very deep, and it becomes necessary to frame the joists up to the level of the top flange, is to bolt a steel angle along the web of the girder to form a shelf to support the joists.

There are many layouts wherein the floor-joists may be supported directly on top of the steel girders, as, for example, where the girders would come within closet space and their projection below the ceiling level would not be noticed. This of course is the simplest and strongest way, for the joists

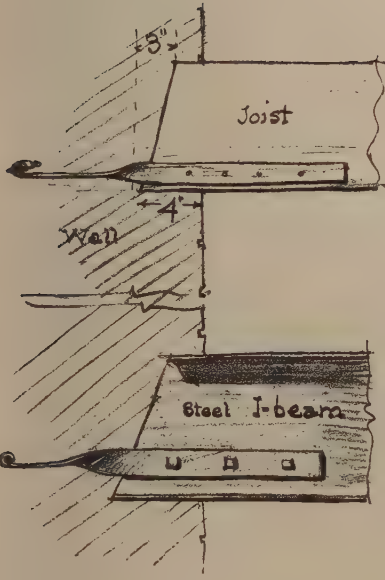


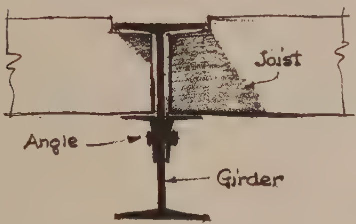


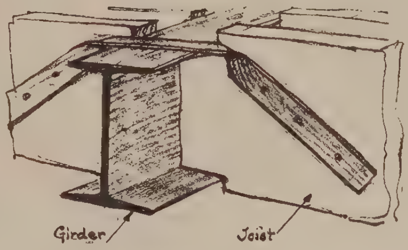
Actual Example of how joists are cut for a pipe

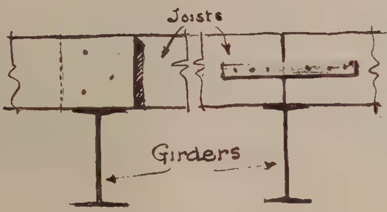


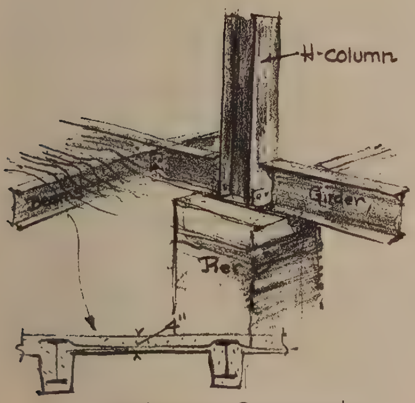
Bridging every 8'feet of Span



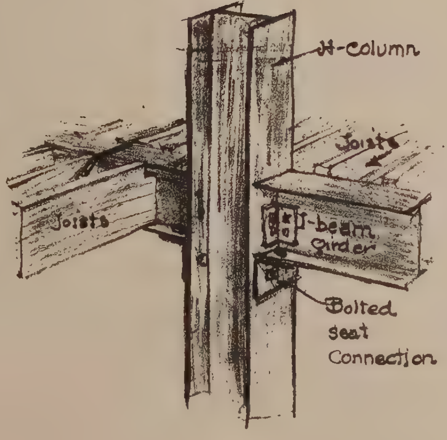


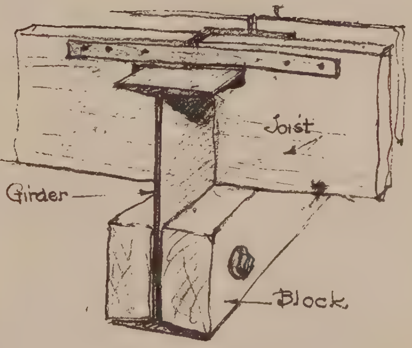






First Floor Construction





can have their ends over the girder lapped and spike together.

This need of fastening together the ends of the joists which are supported upon the girder is rather important. Every 6 feet the joists are anchored into the walls, and unless these same joists are tied together over the girder they cannot properly act as a bond between one wall and the other, and so the floor will not add much stiffness to the walls. The girders, too, are anchored to the walls at the ends with the same kind of anchors used on the wooden floor beams, which makes it necessary to tie them together at the columns, so that they will act as braces to the wall at right angles to the joists. Now there are a number of ways by which the joists may be tied together at the girder. If they merely rest upon the top, it is quite simple to lap their ends and spike them together or to butt their ends together and spike an iron strap to their sides across the joint. But when the joists are cut down so that they are resting upon the lower flange of the girder these methods are not practical. Under these conditions an iron strap may be spiked diagonally across the side of one joist so that it will extend up over the girder. When this strap passes over the top of the girder it may be twisted to make its flat side lie horizontally upon the top flange, and then it may again be twisted back to the vertical position so that it can be fastened diagonally to the side of the joist on the other side of the girder. If the tops of joists come above the level of the girder flange, a piece of the end of them may be left to extend over the upper flange and butted with the end of the opposite joists, and these fastened by straps across the joists. A so-called "iron-dog" may be used, too, which is a metal strap laid across the tops of the joists, but notched down into them at the ends, much on the same principle as a very flat brad would hold two edges of carpet together.

It must not be forgotten that those floor-joists which run parallel to the outer walls need to be anchored to them with 4-inch metal anchors dovetailed into the beams diagonally, crossing at least four beams.

There are a number of openings that need to be framed around in apartment-house floors, such as dumb-waiter shafts, clearance room for chimneys in the walls, and space for bathroom pipes. The trimmer beams which go by the sides of these small openings are not doubled as in the frame house, but if the joists are 3 inches by 8 inches they may be increased to 4 inches by 8 inches, and the header beams suspended across from one to the other on iron stirrups or hangers. The ends of the joists supported by this header beam are also hung in metal hangers.

This same type of framing is used about chimneys which are run up in the walls, for it is necessary to keep all of the framing timber at least 4 inches away from them, and this space should be filled with fire-stopping.

Wherever branch soil lines are run within the floor construction it is easier and safer to frame the joists around an opening wherein the pipes can be run, and then to build up the floor within this opening with smaller timbers arranged to fit the conditions imposed by the layout of the pipes. Moreover, the floors of the toilets will be tiled, and this needs a cinder concrete base of about 3-inch thickness. By constructing a small floor within the framed opening of the larger one, using 3-inch by 4-inch joists across the narrow way, and covering these with rough flooring, plenty of room is left on which to lay the cinder concrete and bring the tile up to the level of the other floors. Moreover, this avoids the danger of butchery which is so dear to the heart of the plumber when he sees a floor-joist he can tackle.

One can see, often, examples of the plumbers' way of treating structural members. When large soil lines have to come down through partitions in line with a floor-joist, the plumber has no hesitation to saw or have sawed for him a whole section out of the joist, leaving air in place of a joist through which the pipe easily can pass. A couple of boards nailed on both sides of the pipe and to the remnants of the joist are considered satisfactory. And yet such careless work receives no rebuke, and even the floor goes on standing up without any protest, the mutilated joist hanging by the nails that fasten the upper rough flooring to it. One can imagine how the technical designer who sends out his specifications or drawings from an office, but who rarely sees his building in the process of erection, would be shocked by such an occurrence.

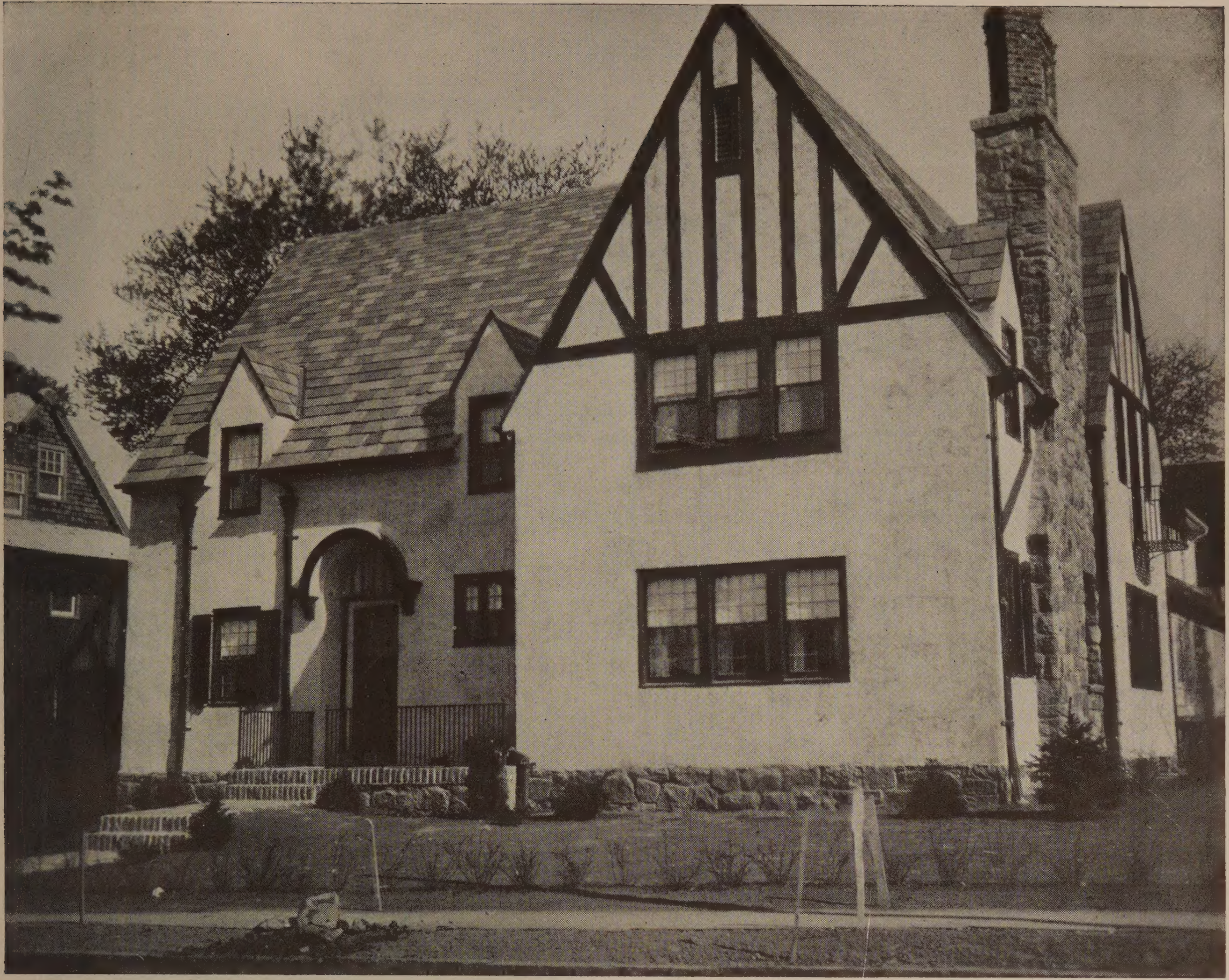
But there is a magic unit of construction in a wooden joist-floor when all the upper edges of the timbers are held together with rough overflooring and finished flooring and the sides braced with diagonal bridging of 1-inch by 3-inch stuff, located at least once in the span, but not farther apart than 8 feet. Heavy concentrated loads are distributed over many joists, and the weakness of one joist so roughly treated by the plumber is upheld by the other ones.

Over the cellar and over the main hall on the first floor must be constructed fireproof floors. These are practically always built of steel I-beams, spaced about 8 feet apart which hold up 4-inch-thick concrete floors reinforced with wire mesh, swung over the tops of the beams. The under sides of the I-beams are protected with a covering of at least 1½ inches of concrete.

On top of these floors is spread cinder concrete in which sleepers are imbedded and to which the rough flooring is nailed. Another method is to lay rough 2-inch by 4-inch timbers edgewise on top of the slabs, notching and cutting them over the inequalities and over the tops of the beams, and then upon them to erect small blocks which in turn uphold 2-inch by 4-inch members placed edgewise. These timbers are spaced 16 inches on centres and serve as a nailing for the rough wooden underflooring, and make it possible to have the flooring at the desired level, giving room for pipes underneath.

The steel floor beams are supported on steel girders which run parallel with those on the upper floors which support the wooden floors, but these girders are held on the top of brick piers which also serve as the base for the steel columns that extend up through the other floors to hold the other girders. The location of these piers varies with the plan of the building. Sometimes they are decidedly out of line with each other, and the girders run back and forth in a zigzag line through the building. On an average they are spaced to make the span of the steel girders from 10 to 15 feet. This makes it possible to use on the upper floors Bethlehem sections for the steel girders, about 8 inches deep. The usual I-beams for the first floor are 8 inches deep, too, and the girders are about 12 inches or 15 inches deep.

(*To be continued*)



HOUSE FOR DOCTOR HERMAN SCAISON, MOUNT VERNON, N. Y. Stern & Peyser, Architects.

### Charles R. McNeil

It is with much regret that we announce the death of Charles R. McNeil, architect, who died in New York City on May 1. He was born in Litchfield, Conn., and was a graduate of the School of Mines, Columbia University, 1894. Mr. McNeil was associated with James Ross, under the firm name of Ross & McNeil, since 1899. The business will be continued under that name.

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## Book Reviews

PAINTER AND SPACE, OR THE THIRD DIMENSION IN GRAPHIC ART. By Howard Russell Butler. Charles Scribnew's Sons, New York.

Mr. Butler is a painter of distinction, a member of the National Academy, and a student of science as well. In these days of all sorts of queer and meaningless isms, it is a pleasant task to read a book on art by a writer who really knows what he is talking about. Art may be a God-given gift, but if it is to manifest itself in something better than bad drawing and worse imaginings, it needs to be cultivated. Right conceptions of form and substance and harmonized color are not to be had for the asking, and we have a surfeit each year of the stuff called art by impudent and decadent seekers after notoriety. Mr. Butler brings us sanity and clear vision to a discussion of essential principles of all good art, but with especial reference "to trace the sequence in the discovery and application of the principles (and the methods based on them) of producing the effect of space in a picture—the principles on which the effect of a third dimension is rendered, the slow evolution of the ages."

There is at present an attempt to revolutionize the art of painting, without a knowledge of principles, and the builders of the temple of modernistic art find themselves often "in the air." And most of us are in the same transparent medium when we are invited to gaze upon the rot that comes of trying to build upon so thin a substance.

Readers will be especially interested in Mr. Butler's chapters on "Binocular Perspective"; "Atmospheric Perspective," with the discussion of correct values, illustrated with a series of six colored plates; "Impressionism and Post-Impressionism"; "Short-hand Method of Sketching," and the especially interesting one on his experiences in "Painting the Solar Eclipse," illustrated with quite a remarkable color-plate.

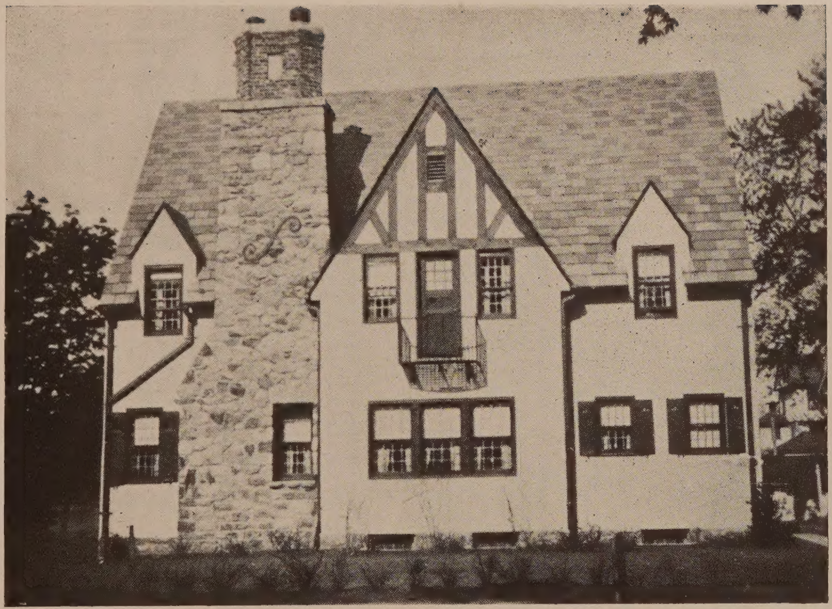
ARCHITECTURE AND DECORATIVE SCULPTURE OF THE HIGH AND LATE RENAISSANCE IN ITALY. By Conado Ricci. With 340 illustrations. Brentano's, New York.

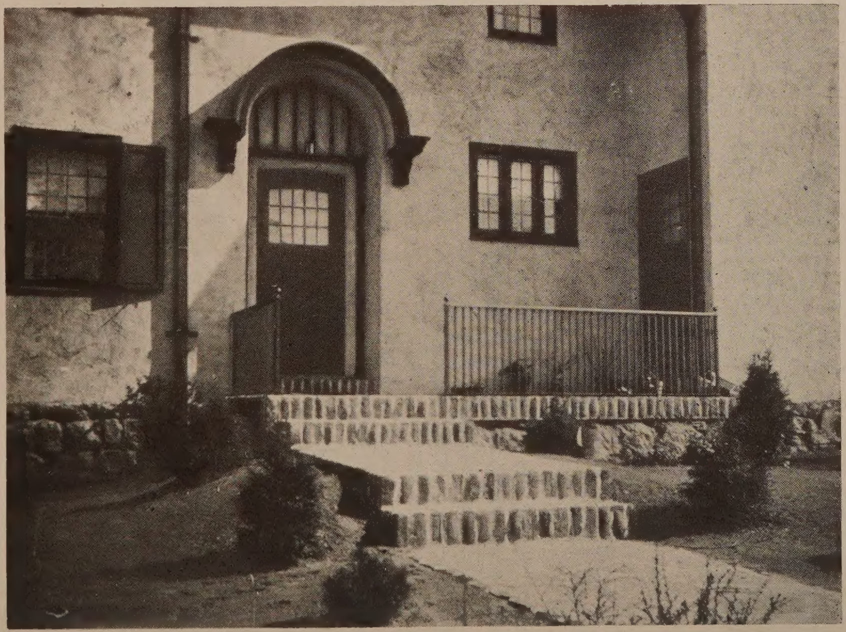
This is another of a series of notably illustrated books that have come to us by way of German printers. The plates are admirable and cover a great variety of details that the architect will value. There is a short but comprehensive introduction, a list of plates, giving their sources, and a list of artists. It gives a pictorial survey of the best work of the Renaissance.

CATALOGUE OF THE EXHIBITION OF AMERICAN SCULPTURE HELD BY THE NATIONAL SCULPTURE SOCIETY—MCMXXIII. 156th Street, west of Broadway, New York, April 14th to August 1st.

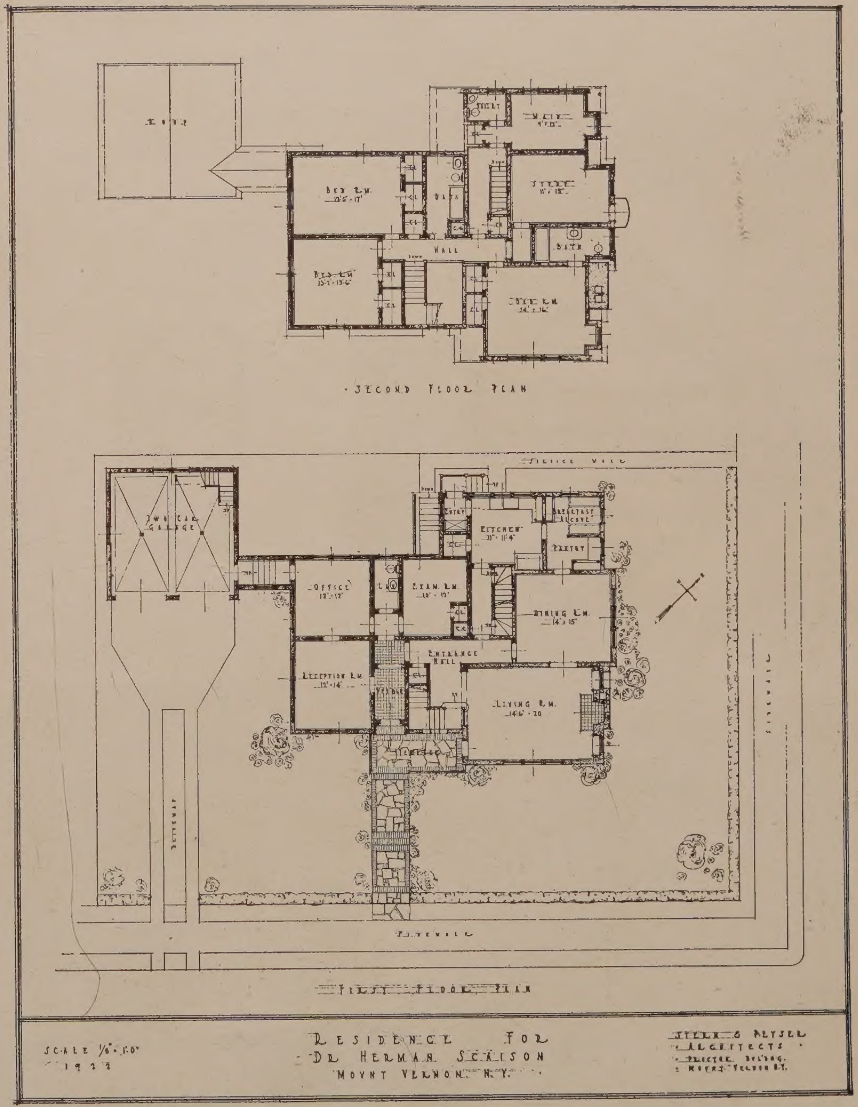
This exhibition is one of the most notable and beautiful ever held in New York, and this handsome catalogue is in keeping with it.

It contains a number of illustrations of sculpture, medals, and plaques, a list of sculptors and their exhibits, an index to sculptors and medalists, and brief biographical sketches. As an index and key to American sculpture it is invaluable.





ENTRANCE.



Stern & Peyser, Architects.

HOUSE FOR DOCTOR HERMAN SCAISON, MOUNT VERNON, N. Y.

# Announcements

Arden Gallery, 599 Fifth Avenue, announces an exhibition and sale of country house and garden furnishings and decorative material, comprising a large and interesting collection of old pewter, many original pieces of iron furniture, garden jars, and wall fountains, linen, tea sets, pillows, wall panels, and porch chairs, painted furniture, lamps, and shades. Mrs. John W. Alexander and Mrs. James C. Rogerson.

The New York office of John Mead Howells and Raymond M. Hood, associated architects, will be at No. 18 East 41st Street, New York City, after May 1, 1923; Chicago office: Monroe Building; telephone, Dearborn 2559. The personal office of John Mead Howells, architect, will remain as before at 367 Lexington Avenue, New York City.

Willard Osler and Lee Burns announce the opening of an office for the practice of architecture at 241 North Pennsylvania Street, Indianapolis, Ind.

We have received the new "Data Book" published by the Bishop & Babcock Co., Cleveland, Ohio, giving complete and valuable technical information regarding their heating and ventilating equipment. It should be on file in the architect's library.

"The Hoffman Book for Architects and Others Who Are Interested in Technical and General Data Concerning the Installation of Gas-Fired Water Heaters and Systems," comes to our desk in an attractive and serviceable form.

Every one considers himself fortunate who receives the "White Pine Series of Architectural Monographs." Number 2 of Vol. IX deals with "The River Towns of Connecticut." There is an introduction by William D. Foster, and illustrations from photographs by Kenneth Clark.

From Chicago comes an illustrated booklet showing the work of Mr. J. Faherty's associates and staff in the local improvements carried out in the great city of the lakes.

Oman & Lilienthal, architects and engineers, Chicago, are pleased to announce the formation of a partnership beginning May 1, 1923, for the general practice of architecture and engineering, with offices at 64 West Randolph Street, Garrick Theatre Building.

John J. Roth, architect, announces the opening of an office at 7060 Hollywood Boulevard, Hollywood, Calif., for the practice of architecture.

Rudolph P. Miller, formerly superintendent of buildings for Manhattan and first chairman of the Board of Standards and Appeals of the City of New York, begs to announce that he has resumed practice as consulting engineer with offices at 25 West 45th Street, New York City.

H. Francis Harrison, architect, 3811 East 26th Street, Kansas City, Mo., would be glad to receive catalogues and samples.

The business of the late John K. Green, manufacturer of the Perfect safety window guard, will be carried on by Mrs. Ella D. Green, at 15 East 40th Street, New York.

Frederick C. Klawiter, A. I. A., architect for A. Moorman Company, bank builders, of St. Paul, Minn., announces his resignation from this firm. Mr. Klawiter will open offices in St. Paul, Minn., at 2077 Fairmount Avenue, to engage in private practice of architecture, specializing in the planning and designing of bank buildings and equipments. Manufacturers' samples and catalogues requested.

John L. Barth, 141 Newark Avenue, Bloomfield, N. J., has opened an office at the above address, and desires to receive manufacturers' catalogues, with special reference to hospital work.

A. Storrs Barrows, architect, desires to announce the opening of his new studio at 56 James Street, Rochester, N. Y. A visit from you will always be welcome.

Lincoln Norcott Hall, A. I. A., architect, announces the removal of his office to 7 West Madison Street, Chicago, Ill.

At the annual meeting of the National Terra Cotta Society at Atlantic City, N. J., April 21, 1923, Mr. E. V. Eskesen, president of the New Jersey Terra Cotta Company, was elected president of the society for the ensuing year. The remaining officers are: Mr. O. W. Ketcham, first vice-president; Mr. Adolph Hottinger, second vice-president; Mr. Walter Geer, Jr., treasurer, and Mr. F. S. Laurence, executive secretary.

Mr. Eskesen was knighted by the king of Denmark April 30, 1923, being decorated with the Order of Daneborg in recognition of his services in promoting the common interests of the Danish-American peoples, especially in the interchange of university scholarships, etc., between the two countries.

*Additions to the Selling Staff of Edward Smith & Co.*—Two additions have been recently made to the selling staff of Edward Smith & Co., varnish, color, and enamel manufacturers, Long Island City, N. Y. Mr. R. L. S. Doggett, who so ably represented Valentine & Co. in New Jersey for twelve years, resigned from that firm the first of the year and has associated himself with Edward Smith & Co. to represent them in his old territory. Mr. Geo. C. Clark, who formerly represented Edward Smith & Co., has returned to the fold and is working among his old friends and customers in New York City.

*Consulting Materials Engineer Joins Dwight P. Robinson Staff.*—Mr. Cloyd M. Chapman has become affiliated with Dwight P. Robinson & Company, Incorporated, as consulting materials engineer. Mr. Chapman, who has been active in the work of the American Society of Testing Materials and the American Concrete Institute, will in the future represent Dwight P. Robinson & Company in the committee work of these societies.

DeCurtins, Rawson & Tolan, architects and superintendents, 503 Opera House Building, Lima, Ohio, advise us that after May 1 their offices will be located at 8 and 9 Eilerman Building.

Michael S. Diamond, architect, 30 Bay Street, Saint George, Staten Island, New York, would like to receive manufacturers' catalogues and samples for the purpose of renewing his files.

# Does Your Battleship Linoleum Specification *INSURE* the Kind of Job You Want?

It goes without saying that the first purpose of your specification is to define a standard of quality in material that will meet your client's flooring requirements.

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### A Standard that is Nationally Recognized

"U. S. Navy Standard—Walton Process" is the only term that defines a standard of quality that is recognized by the entire industry. It designates a grade of battleship linoleum that has proved its merits under the most exacting service conditions.

The inclusion of the words "Walton Process" is of the utmost importance, because Walton Process battleship linoleum is infinitely superior to linoleums produced by cheaper short-cut methods. These other process linoleums may occasionally pass Navy tests when fresh from the factory, but they lack the inherent quality that makes for satisfactory service.

### Assures Maximum Competition

"U. S. Navy Standard, Walton Process" is the only term that will permit maximum competition on a basis of definite quality. Linoleum that will meet the exacting tests of the U. S. Navy Specification will meet all the service requirements of *any* floor where battleship linoleum is at all suitable.

Should you specify a single manufacturer's brand, you will in no way raise the standard of quality, yet very decidedly limit competition. When you employ such terms as "Heavy Battleship Linoleum" and "Government Standard Linoleum," you define no definite standard of quality and open the door to unscrupulous bidders who skimp on quality.

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To secure a floor that will give the utmost in satisfactory service at a price based on unrestricted competitive bidding, use the term "U. S. Navy Standard, Walton Process."

As the largest concern in the country specializing in the installation of resilient floors, we are vitally interested in the service rendered by all floors of this type, whether installed by us or not. Our flooring engineers will gladly give you the benefit of their wide experience in the solution of any troublesome flooring problem. Write our nearest office.

The following types of resilient floors are installed by this company and are guaranteed by a 5-year Surety Bond, issued by the U. S. Fidelity & Guaranty Company.

*Gold-Seal* Battleship Linoleum
*Gold-Seal* Treadlite Tile
Marbleized Rubber Tile
Natural Cork Tile

**BONDED·FLOORS·COMPANY**
INCORPORATED
**FLOORING·ENGINEERS·AND·CONTRACTORS**

New York Chicago Boston Cleveland Detroit
San Francisco Los Angeles Newark Jamaica

*"A surety bond with every floor"*